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# Cycling for transport and recreation: Associations with socio-economic position, environmental perceptions, and psychological disposition

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ABSTRACT

*Objective.* Interest is growing in promoting utility cycling (i.e., for transport) as a means of incorporating daily physical activity (PA) into people's lives, but little is known about correlates of utility cycling. Our primary aim was to examine cross-sectional relationships between socio-economic characteristics, neighborhood environment perceptions and psychological disposition with utility cycling (with or without additional recreational cycling). A secondary aim was to compare these relationships with those for recreation-only cycling.

*Method.* Baseline survey data (2007) from 10,233 participants in HABITAT, a multilevel longitudinal study of PA, sedentary behavior, and health in Brisbane adults aged 40–65 years, were analyzed using multinomial regression modeling.

*Results.* Greater income, habitual PA, and positive beliefs about PA were associated with utility and recreation-only cycling ($p < 0.05$). Always having vehicle access and not in the labor force were associated with recreation-only cycling ($p < 0.05$). Some or no vehicle access, part-time employment, and perceived environmental factors (little crime, few cul-de-sacs, nearby transport and recreational destinations) were associated with utility cycling ($p < 0.05$).

*Conclusion.* Our findings suggest differences in associations between socio-economic, neighborhood perceptions and psychological factors and utility and recreation-only cycling in Brisbane residents aged 40–65 years. Tailored approaches appear to be required to promote utility and recreational cycling.



## Introduction

Governments in low cycling countries are promoting utility cycling (cycling for transport) as a means of incorporating physical activity (PA) into people's daily lives and consequently improving their health (Oja et al., 2011) and reducing carbon dioxide emissions (Rojas-Rueda et al., 2011). In Australia, the National Cycling Strategy presents priority government actions for increasing cycling (Ausroads Ltd., 2010). Actions include promoting utility cycling, improving bicycle infrastructure and end-of-trip facilities, and integrating cycling needs in transport and land use planning (Ausroads Ltd., 2010). Census data indicate that such actions may be effective: from 2006 to 2011 the percentage of Australians traveling to work by bicycle increased by 15% (Australian Bicycle Council, 2013). However, bicycle mode share to work remains low, 1.3% (Australian Bicycle Council, 2013), similar to rates in the U.S. and UK but low compared with some European countries (Pucher and Buehler, 2012).

According to the ecological models (Sallis et al., 2006), strategies to increase utility cycling must be multi-level, accounting for individual factors as well as the social and physical environmental contexts. Evidence about the relationship between individual characteristics and utility cycling is growing (Beenackers et al., 2012; Bopp et al., 2012; Heinen et al., 2009; Titze et al., 2007, 2008, 2010): utility cycling is associated with younger age and being male in low cycling countries like Australia (Bopp et al., 2012; Garrard et al., 2008; Sahlqvist et al., 2013; Titze et al., 2010; Winters et al., 2007). There are inconsistent findings for socio-economic characteristics like income (Heinen et al., 2009). The evidence supporting associations between psychological factors and utility cycling is also limited but suggests that constructs from the Theory of Planned Behavior (e.g., attitude) influence decisions to cycle to work (Heinen et al., 2009). Of the subjective environment, the perceived presence of destinations has received the most attention as a correlate of commuting cycling (Beenackers et al., 2012; Heinen et al., 2009).

Studies examining utility cycling correlates have compared utility cyclists with non-utility cyclists. This is problematic because non-utility cyclists include recreation-only cyclists, who are likely to have different perceptions about cycling than non-cyclists. Our primary aim was to use an ecological model to examine cross-sectional associations

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between utility cycling (with or without additional recreational cycling) and socio-economic characteristics, perceptions of the neighborhood environment, and psychological disposition, with non-cyclists serving as the referent group. A secondary aim was to compare these associations with those for recreation-only cycling.

## Methods

### *Sample and procedure*

Baseline data from HABITAT, a study of PA, sedentary behavior, and health in adults aged 40–65 years and residing in Brisbane, Australia, in 2007, were used for these analyses. As reported previously (Burton et al., 2009), a multi-stage probability sampling design was developed to select a stratified random sample of Census Collector's Districts (CCDs), and within each CCD, adults aged 40–65 years were randomly selected. CCDs are used by the Australian Bureau of Statistics to collect census data and in Brisbane, compose an average of 200 households with similar socio-economic characteristics. Selected adults were mailed a self-administered questionnaire between May and July, 2007 (Turrell et al., 2010). For the current analysis, factors hypothesized to be associated with cycling based on previous research (Bopp et al., 2012; Heinen et al., 2009; Panter and Jones, 2010; Titze et al., 2010) were examined. In total, 11,036 (68.5% response rate) usable surveys were returned, and participants were representative of the general Brisbane population (Turrell et al., 2010). The University Human Research Ethics Committee at Queensland University of Technology provided ethical clearance (Ref. No. 3967H).

### *Cycling behavior*

Participants reported the frequency of recreational cycling ('cycling for exercise or recreation') in the last 12 months (6 response options, from 'never' to 'more than once a week') and the time (hours and minutes) 'spent cycling for transport in the last week'. They were instructed that cycling for transport includes 'travel to and from work, to do errands, or to go from place to place' and to not include time spent cycling for exercise or recreation in their estimations. Participants were categorized as: (1) non-cyclists if they reported recreational cycling less than monthly and no minutes of utility cycling; (2) recreation-only cyclists if they reported recreational cycling at least monthly and no minutes of utility cycling, and (3) utility cyclists if they reported any minutes of utility cycling in addition to any reports of recreational cycling. Most utility cyclists (88.9%) were recreational cyclists.

### *Socio-demographic variables*

Participants reported age, sex, and household composition. As measures of socio-economic position, they reported gross household income (11 categories collapsed into 4 and an additional missing category), employment status (10 categories collapsed into full-time, part-time/casual, and not in the labor force), and availability of a motor vehicle for personal use (yes, always; yes, sometimes; no).

### *Perceptions of the neighborhood*

Scales and items that form the abbreviated version of the Neighborhood Environment Walkability Scale (NEWS-A) (Cerin et al., 2007; Saelens et al., 2003) with acceptable reliability (Turrell et al., 2011) were used. These included scales measuring traffic volume, aesthetics, and crime in the neighborhood. Item responses were on a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree). Counts of recreational facilities (e.g., bike path, public park) that participants reported were located within a 5-min drive and separately of transport destinations including public transportation (e.g., supermarket, post office, train station, bus stop) within a 20-min walk were calculated and treated as continuous variables. Five individual items about the neighborhood streets were also included: many traffic slowing devices in the suburb, many streets having cul-de-sacs (reverse coded), many four-way intersections, and many hilly streets. Responses were on a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree), and were grouped into agree (response of 4 or 5) or disagree/neutral (response of 1–3) as done previously (Titze et al., 2010).

### *Psychological factors*

In keeping with an expanded Theory of Planned Behavior (Montano and Kasprzyk, 2008) and supported by studies of utility cycling (Heinen et al., 2009), theoretical constructs included attitude towards PA (affective and instrumental), social support for PA, self-efficacy towards PA, and PA habit. Scales from previous work with acceptable measurement properties were used (Burton et al., 2007; Sallis et al., 1997). Item responses were measured on a 5-point scale. Responses ranged from strongly disagree (1) to strongly agree (5) except social support responses ranged from never (1) to very often (5).

### *Analysis*

Analysis was carried out with STATA/SE 11.2 (StataCorp, College Station, Texas). Principal components analysis with VARIMAX rotation was conducted to assess factor structure of all scales, and Cronbach's alpha was computed as a measure of internal consistency of each scale. After removing one item from the crime scale ('there are unsecured dogs in my suburb'), all scales had adequate measurement properties (see Supplementary material A), and the mean score of scale items was computed to create a composite scale score. Scores on scales measuring perceptions of the neighborhood were collapsed into tertiles based on the distribution of the data. Descriptive statistics were generated for all variables.

A series of multivariable multinomial regression models was computed to examine the separate and joint influence of socio-economic, perceived environment and psychological factors on utility and recreation-only cycling behavior. In the first model, socio-economic variables were the predictor variables. In the second, environmental factors were the predictors, and in the third, psychological variables were the predictors. The final model included all predictor variables found to be significant in a previous model at $p < 0.10$. All models were adjusted for age, sex and household composition, and to account for clustering of participants within CCD, the survey (*svy*) command in STATA/SE was used. Statistical significance was set at $p < 0.05$.

Before modeling, careful attention was made to correlations among predictor variables, to confirm that these variables were not highly correlated ($r < 0.70$), and thus to prevent multicollinearity. After final modeling, multicollinearity testing was conducted: models were rerun as OLS regression models and Variance Inflation Factors (VIFs) were checked. All VIFs were low (<2), indicating that multicollinearity was not present. Also after final modeling, the Hausman test (*suest* command in STATA/SE) was run for all models to check for independence of irrelevant alternatives, and no evidence against the correct specification of the multinomial logic for any model was found.

## Results

Of 11,036 eligible participants, two were excluded based on age; 238 (2.2%) were excluded because they were missing cycling data; and 563 (5.1%) were excluded because they were missing data on predictor variables (≤2.0% of data from any predictor were missing). Thus, data from 10,233 were included in the analysis. Excluded participants were more likely to be female, single, in low income households, and not in the labor force ($p \leq 0.001$), and less likely to have favorable perceptions of their neighborhood environment, to have social support for PA, or to have made PA a habit ($p < 0.05$; see Supplementary material B).

Of the analytical sample, 18.0% were categorized as recreation-only cyclists, and 3.8% as utility cyclists, who tended to also be recreational cyclists. Most recreation-only cyclists (54.2%) cycled at least weekly, while utility cyclists averaged 120 min of utility cycling in the previous week (IQR 60, 240). Descriptions of the sample are displayed in Table 1.

Results of regression modeling are shown in Tables 2–3. Table 2 shows that as household income decreased, odds of cycling for recreation only and utility decreased. The odds of recreation-only cycling were lower for participants having no motor vehicle access and for those outside the labor force while the odds of utility cycling were higher for participants with no or sometime motor vehicle access and for part-time/casual workers. Five perceived environment factors were associated with cycling. The odds of recreation-only cycling were higher for those who perceived the most neighborhood greenery. In contrast, greenery was not associated with utility cycling, but perceived crime