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Appearance and behaviour: Are cyclist physical attributes reflective of their preferences and habits?

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ABSTRACT

Cyclist physical attributes are important for performance aspects such as speed, effort, and energy expenditure, and could also be systematically related to preferences and behaviour. Casual assumptions (stereotypes) about cyclists based on their appearance are common among road users but largely untested. This study examines whether readily observable physical attributes are significantly associated with cycling efficiency, preferences, and habits for a sample of 531 intercepted cyclists in Vancouver, Canada. Due to strong correlations among physical attributes, a typology is developed using cluster analysis based on physical aspects of the bicycle (bicycle type, tire type, tire width, tire pressure, and cargo) and rider (apparel and riding position). Results show that Mountain, Hybrid and Road type cyclists are, in that order, systematically more efficient, more comfortable on major roads, cycle more consistently year-round, cycle faster, and engage in more vigorous physical activity. Still, the hypothesis of significant relationships between appearance and behaviour is only weakly supported: behaviour differences among cyclist types are modest and wide ranges of preferences and behaviours within the physical clusters could be viewed as a refutation of common cyclist stereotypes. For application of the physical typology, readily observable attributes such as tire type can be used as indicators to infer resistance parameters and more generally characterize a sample of cyclists. This study establishes associations, not causality, and future work should examine a potential positive feedback effect between equipment efficiency and cycling frequency.

1. Introduction

Cycling in urban environments has been fostered by many cities around the world, with goals such as reducing congestion and pollution emissions and increasing physical activity (Pucher et al., 2011; Pucher and Buehler, 2012; Su et al., 2010). As urban cycling grows, there is an accompanying need to develop more sophisticated bicycle travel modelling tools, including behavioural, safety, health, and operations models. Better understanding and representation of bicycle travelers can improve models and contribute to the design of more targeted cycling policies, which has motivated development of several cyclist typologies (Damant-Sirois and El-Geneidy, 2015; Dill and McNeil, 2013; Gatersleben and Haddad, 2010; Piatkowski and Marshall, 2015; Winters et al., 2011).

To date, cyclist physical attributes have been largely excluded from bicycle transportation analysis, limiting consideration of important aspects of physical performance including speed, power, energy expenditure, and breathing rates (Bigazzi and Figliozzi, 2015; Tengattini and Bigazzi, 2017). Physical performance is important for outcomes such as health and safety, and can also affect travel behaviour through influences on route and mode choices. For example, cyclist avoidance of hills is likely related to the excess energy and time required to ascend them, and decisions about whether to cycle are related to the perceived physical effort required.

Physical characterization of cyclists can include several types of attributes, some readily observable (bicycle type, clothing, riding position) and others more difficult to measure (resistance parameters). Bicycle resistance forces are important determinants of required pedaling effort and commonly parameterized as the coefficient of rolling resistance C_r (unit-less), and the effective frontal area $A_f C_d$ (m^2) (Bigazzi and Figliozzi, 2015). Mass m (kg) of the cyclist, bicycle, and cargo also directly influence required pedaling effort. Various other physical attributes of the cyclist and bicycle are related to resistance parameters and so can indirectly affect pedaling effort, such as tire pressure and width, riding position, and cyclist body size and shape (Burke, 2003; Wilson and Papadopoulos, 2004). These other physical attributes are often easier to determine for a sample of cyclists than the resistance parameters, which require more invasive measurement

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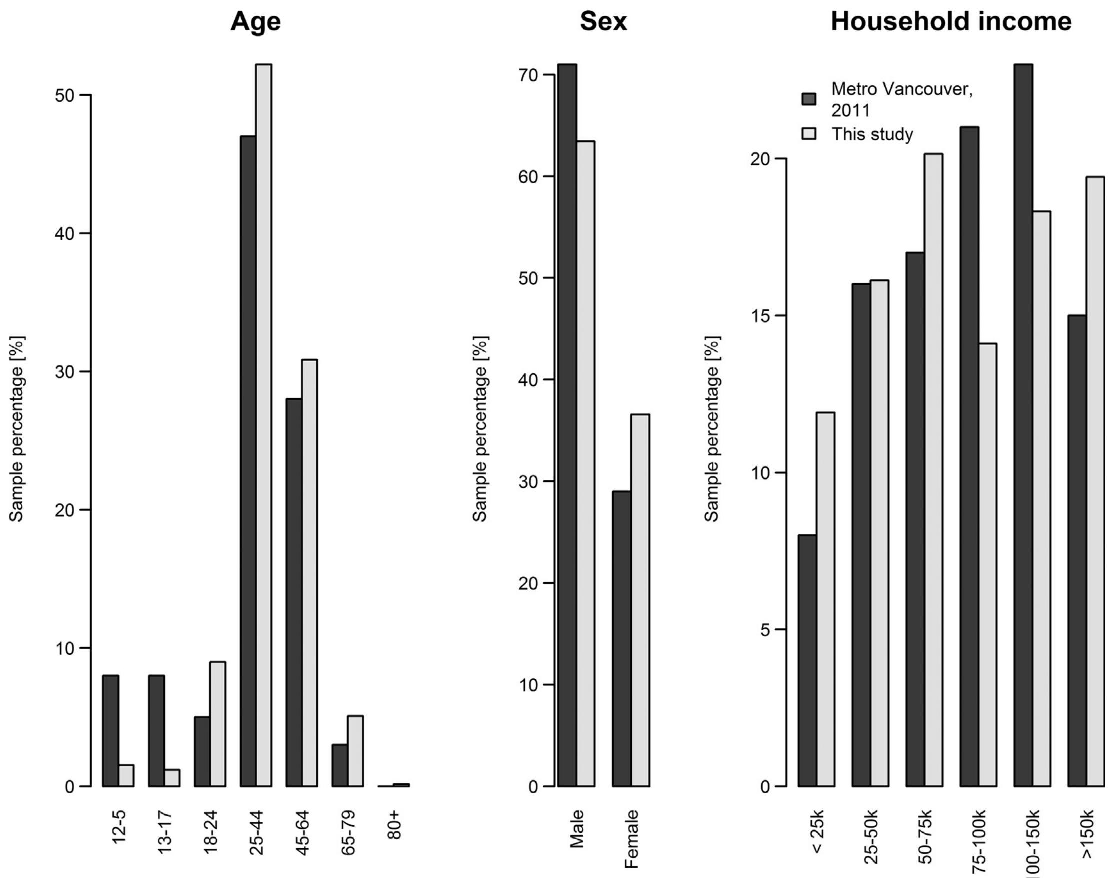

Fig. 1. Comparison of sample with cyclists in a 2011 regional household travel survey (TransLink, 2013).

methods than simple observation.

The extent to which cyclist preferences and habits are systematically related to their physical attributes is still unknown. Observable and unobservable physical attributes could influence behaviour through cycling efficiency, and conversely also be manifestations of cyclist identity and preferences, which also influence behaviour. Casual and largely untested assumptions (stereotypes) about cyclists based on their appearance are common among road users, such as cyclists with more "sporty" gear being more confident on their bicycles and on higher-traffic routes. In previous research, cyclist appearance has been described as a barrier to wider acceptance of cycling, a reflection of cyclist identity, and a mechanism for normalizing urban cycling (Aldred, 2013; Aldred and Jungnickel, 2014; Daley and Rissel, 2011; Fishman et al., 2012; Gatersleben and Haddad, 2010; Goodman et al., 2014).

The objective of this paper is to examine whether readily observable physical attributes of cyclists are systematically related to their cycling efficiency, preferences, and habits. Due to strong correlations among physical attributes, a physical typology is developed using cluster analysis, based on data from an intercept survey of urban cyclists in Vancouver, Canada. Relationships are then examined between cyclist physical types and (1) cycling efficiency, as represented by resistance parameters; (2) cyclist preferences, such as comfort on different types of roadway facilities; and (3) travel habits, such as self-reported cycling frequency and seasonality. The physical types are also compared to the well-known preference-based "four types of cyclists", originally developed by Roger Geller in Portland, Oregon (Geller, 2009). The two main goals of this research are to test the hypothesis that cyclist appearance is systematically related to non-physical attributes such as preferences and habits, and to determine whether readily observable physical attributes such as bicycle type can be used as an indicator to more generally characterize a sample of cyclists.

2. Method

A cyclist intercept survey was conducted in Vancouver, Canada at 9 locations over 18 days in summer 2016. Locations were selected to sample from a variety of contexts (university, residential, downtown, waterfront path). Passing cyclists were recruited with signs placed within one block of the survey location. Participating cyclists (648 in total) first completed a questionnaire with socio-demographic, current trip, cycling preference, and general travel behaviour questions. Simultaneously, cyclist and bicycle physical attributes were measured, including masses, cargo, and tire pressure, type, and width. Participants then completed a coast-down test, which involved coasting from a cruising speed to a stop over approximately 100 m of paved bikeway, from which resistance parameters were determined. Details of the coast-down test method are given in Tengattini and Bigazzi (2018a). The estimated resistance parameters (rolling resistance, C_r, and effective frontal area, $A_f C_d$) represent the first- and third-order effects of speed on power.

Cluster analysis was applied to develop a physical typology using only observed physical attributes directly assessed by the researchers during the survey. Estimated resistance parameters and questionnaire responses were excluded to create a typology that is easy to apply and based on readily observable attributes. Categorical variables were bicycle type (Road, Hybrid, Mountain, Cruiser, or Other, based primarily on frame geometry and handlebar type); tire type (Slick, Commuter, or Knobby, with decreasing smoothness); cyclist apparel (Sport or Casual); and riding position (Drops, Hoods, or Tops, decreasingly aerodynamic). Bicycle, tire, apparel, and position classifications were designated and aligned by the researchers before the survey using example photos of cyclists. Numeric variables were tire pressure, tire width, and number of cargo pieces.