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Cluster analysis of fare evasion behaviours in Melbourne, Australia

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ABSTRACT

Fare evasion on transit can reduce revenue by millions of dollars, undermining financial viability. Research has examined how design solutions, such as ticket barriers and ticket inspections, can reduce fare evasion. However little research examines how transit users think about fare evasion or attempts to understand why people fare evade. This research uses a quantitative cluster analysis to segment fare evasion behaviours into three categories which show distinct personality and behavioural characteristics. A web-based survey of was administered to residents of Melbourne, Australia with a total sample size of 1561. The questionnaire was introduced as a survey about transit travel and ticketing but included questions about various aspects of fare evasion behavior. Notably, three broad types of fare evasion were explored: 'accidental' fare evasion (e.g. meant to pay but machines were not working), 'unintentional' fare evasion (e.g. meant to validate but I was in a hurry or I forgot) and 'deliberate' fare evasion (e.g. decided not to pay because I was only going a few stops). A two-step cluster analysis was conducted using a range of categorical and continuous variables including fare evasion behavior, predicted likelihood of continuing to fare evade, age and frequency of transit use. Three clusters of fare evaders emerged: deliberate evaders, unintentional evaders and never-evaders. Deliberate evaders were the smallest cluster but the most frequent transit users. In contrast, unintentional evaders were more common but only fare evaded infrequently. The clusters also had distinct personality differences; deliberate evaders were more likely to be sensation-seekers and believed it was acceptable to bend the rules to save money. Implications for transit policy and practice are discussed.

1. Introduction

Transit fares are crucially important to defraying system costs and fare evasion is a chronic issue in transit systems around the world. It can reduce revenue by millions of dollars and either increase subsidy requirements or force other passengers to bear higher costs in order to counteract the non-payment of fare evaders. Furthermore, it has been suggested that increased rates of fare evasion can increase perceptions that the transit environment is unsafe (Reddy et al., 2011).

To date, research into fare evasion has focused primarily on enforcement solutions, such as increased ticket inspections, and design solutions, such as ticket barriers (Dauby and Kovacs, 2006; Reddy et al., 2011; Sasaki, 2014; Kooreman, 1993; Killias et al., 2009; Barabino et al., 2013, 2014). Very little research has attempted to understand the reasons *why* people fare evade and how they might vary across a ridership population (with some recent exceptions, Barabino et al., 2015; Bucciol et al., 2013). Customers may fare evade due to income constraints, negative attitudes toward transit, perceived barriers to paying the fare or due to broader personality characteristics. Better understanding the psychology of fare evasion can potentially provide new perspectives into enforcement, infrastructure and marketing interventions.

This paper presents the results of a survey on the psychology of fare evasion conducted in Melbourne, Australia. It is the first work to categorize fare evasion along a spectrum in which the behavior can be either accidental, unintentional or deliberate. A cluster analysis was used to identify market segments that display a propensity toward unintentional or deliberate fare evasion. It provides a rich, in-depth profile of the psychology of fare evasion.

The overall aim of the survey is to use these categories of fare evasion to highlight the behavioural, demographic, personality and attitudinal differences between fare evasion clusters. The research objectives underpinning this aim are as follows:

- Undertake an exploratory cluster analysis of fare evasion behaviours.
- Estimate the prevalence of these behavioural clusters in the population.
- Compare the demographics, attitudes and personality characteristics of the behavioural clusters.

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The findings from this study can provide insights for transit agencies who wish to better understand their customer base. Understanding that motivations to fare evade differ across the customer base implies that policies and interventions may have different effects on different segments of the transit customer population.

This paper is structured as follows. The next section provides a review of existing literature on fare evasion with an emphasis on the limitations to current research. It is followed by a description of the research context, survey methodology and analysis method. Next the results of the cluster analysis are presented and the paper finishes with a discussion of the implications for transit operators reviewing their fare evasion policies and practices.

2. Literature review

Given the challenge of maintaining a cost-effective public transport system, fare evasion has come under attention as a threat to productivity (Pricewaterhousecoopers, 2007, Victoran Auditor-General, 2012). In Melbourne when this research took place, fare evasion rates were rising to over 11% of ridership (May 2012), losing some $AU55M per annum in forgone revenue (average 2005–2011, (Victoran Auditor-General, 2012)). Public Transport Victoria wanted to better understand why people fare evade in order to more effectively manage ticketing and enforcement.

Understandably, most of the literature on fare evasion has focused on how to reduce it through changes to ticketing and infrastructure design or ticket inspection rates. The design of the ticketing system has a direct impact on fare evasion rates. Proof-of-payment, open and honour-based systems (such as adopted in light rail and some bus systems) are more vulnerable to high fare evasion rates (Dauby and Kovacs, 2006), as high as 43% in some jurisdictions (Bucciol et al., 2013; Barabino et al., 2013). 'Closed' ticketing systems with ticket barriers (adopted by most metro and many heavy rail systems) provide less opportunity to fare evade, although some still face unacceptable levels of fare evasion (e.g. Reddy et al., 2011). Each ticketing system has cost implications; pay-on-entry systems reduce fare evasion but significantly increase dwell times for bus and streetcar systems (Tirachini, 2013; Currie et al., 2012), whereas 'closed' barrier systems require the installation and maintenance of ticket barriers (Sasaki, 2014).

Ticket inspection rates have also been shown to have a significant impact on fare evasion rates, with higher inspection rates usually discouraging fare evasion (Kooreman, 1993; Dauby and Kovacs, 2006; Killias et al., 2009) (but not always, see Clarke et al. (2009)). Several authors have attempted to optimize the 'ideal' inspection level to maximize profits (Barabino et al., 2014, 2013).

Until recently, however, very few studies considered fare evasion from a customer perspective (Eddy, 2010), particularly at the time this study was conducted (December 2012[1]). Existing studies tend to focus on the demographics of fare evaders, identifying that young people, males, students and migrants are more likely to fare evade (Bucciol et al., 2013; Barabino et al., 2015). Barabino et al. (2015) expanded their study to examine other characteristics that are associated with fare evasion, including taking short trips, dissatisfaction with the service and using transit frequently.

However two gaps in previous research remain. The first gap is that few studies have quantified the different attitudes and personality characteristics of fare evaders vs. non-evaders. Recent studies from Europe have begun to consider passenger attitudes (Barabino et al., 2015; Bucciol et al., 2013), but only through a single measure of 'satisfaction with bus service'. Although this is an emerging area in transit, there is a wider literature on petty crime and 'consumer misbehaviour' such as shoplifting and vandalizing property (Fullerton and Punj, 1997; Reynolds and Harris, 2009). This body of literature has demonstrated links between consumer misbehaviour, service satisfaction and personality (Fisk et al., 2010; Daunt and Harris, 2011a, 2011b). Drawing from this body of work, the present study is the first consider the potential role of customer satisfaction, customer alienation and whether transit is viewed as a commercial or a social service. It is also the first to consider the influence of a spectrum of personality characteristics such as social beliefs, honesty and aggressiveness.

The second gap is that previous studies all view fare evasion as a deliberate action, a clear state of either law-abiding or law-breaking. None have examined how fare evasion is viewed by the customer base, and whether or not they characterize their own behavior as fare evasion. This paper directly examines this ambiguity, presenting a framework in which fare evasion can be either accidental, unintentional or deliberate.

Building on this premise, cluster analysis methods are then used to identify three motivational clusters: never-evaders, unintentional evaders and deliberate evaders. Cluster analysis is a method that has been used before to examine transport market segments (Anable, 2005; Ralph et al., 2016; Sperry et al., 2011). The next section describes the methods used to formulate these clusters.

3. Methodology

3.1. Research context

This research was undertaken in Melbourne, a city of over 4 million and the capital of the state of Victoria in Australia. Melbourne has a dense urban centre surrounded by low-density suburbs. It is served by a radial heavy rail system connecting the inner city to the suburbs and a largely radial streetcar network in the inner and middle suburbs. The bus system provides local and orbital transit links in middle and outer suburbs. The city is divided into two fare zones with a higher cost associated with travelling between zones.

Transit ticketing is provided by a smartcard system and enforcement varies by mode. Major rail stations have ticket barriers whereas smaller suburban stations use validation machines with proof-of-payment. The streetcar network relies on proof-of-payment with validators on board vehicles. Buses also have ticket validators at entrances and exits with the bus drivers nominally responsible for ensuring that passengers validate on entry and exit.

As is the case in many cities, the transit system in Melbourne is owned by the state government but operated by private operators. There is some public perception that the transit system is run 'for-profit' by these operators (which is explored later in this paper), but the system is heavily subsidised by government revenue for social, economic and environmental rationales.

3.2. Survey method

This survey was part of a large-scale research project into the psychology of fare evasion in Melbourne and included both qualitative and quantitative research. The qualitative research used focus groups to uncover a preliminary segmentation of fare evasion motivations; this is reported elsewhere (Delbosc and Currie, 2015).

For the purpose of this analysis, a web-based survey was

[1] Release of the survey results was delayed at the request of the survey sponsor, Public Transport Victoria, due to the sensitive nature of the topic.