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# The role of information systems in non-routine transit use of university students: Evidence from Brazil and Denmark

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ABSTRACT

In this study we seek to understand the relation between travel information, transit use intentions and night travel. We hypothesize that transit use is related to the perceived usefulness and the ease-of-use of the system, which are related to information quality and real-time information availability. The hypothesized relations are anchored theoretically in the Technology Acceptance Model and validated empirically in two case-studies: (i) Copenhagen (Denmark), characterized by a highly integrated transit system with an advanced web-based information system; (ii) Recife and Natal (Brazil), characterized by a lower perceived level-of-service and non-integrated information sources. Data from a tailor-made survey of 1123 university students were collected. Structural equation models were employed for explaining the use of transit as a function of the observed respondent characteristics and the latent constructs. The results show that: (i) information search quality and source explain transit use; (ii) information quality underlies level-of-service and familiarity; (iii) the use of real-time information links to information quality and familiarity; (iv) general transit use and non-routine use during night and to unfamiliar places are correlated; and (v) the behavioral framework is confirmed with the two case-studies.


## 1. Introduction

The lifestyle of young people is shifting from the traditionally well-rooted and routine lifestyle to a more dynamic one, continuously changing residence place and activity patterns, due to the need for higher education, the competition in the labor market, the need for business travel, higher leisure consumption and globalization. When coupled with growing city complexity and size, this lifestyle, which necessitates people to be constantly on the move in unfamiliar environments, generates high demand for travel information. The more time people spend moving around in complex unfamiliar environments, the more important is getting relevant and reliable information in a clear and efficient format for maintaining the

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activity schedule, as well as saving time and money. Nevertheless, the cost effectiveness of transit information systems and their impact on users' travel patterns and modal shift is unclear. As a result, there are many transit operators that do not provide transit information due to the belief that transit users rely on their past experience and familiarity with the system, word-of-mouth, and operator-specific information (Ibraeva and Figueira de Sousa, 2014). Other transit providers invest in collecting, processing and disseminating real-time information in trip advisor applications (Alves et al., 2012; Farag and Lyons, 2012; Bruglieri et al., 2015). Understanding the relation between information systems and transit use could support transit operators in their decision to invest in advanced information systems.

Recent studies show the importance of seeking transit information for routine travel and long distance trips. In a survey conducted among 200 participants in China, 77% of the respondents sought transit information one to three times in the week prior to the survey, and 77% said that they would like to see transit information before the trip (Hou and Chen, 2013). In a survey conducted in Bristol, respectively 42% and 57% of the respondents sought information always or very often for leisure and business trips over 50 miles within the UK, while 57% obtained transit information for unfamiliar trips (Farag and Lyons, 2012). An experiment in the corridor between Liverpool and Chester showed that better information about price reduction was associated with a significant ridership increase (Ibraeva and Figueira de Sousa, 2014). The mobile application for transit information in Melbourne (Australia) is downloaded more than 4000 times a week (Ibraeva and Figueira de Sousa, 2014). In an experiment conducted in Japan regarding a new information system on-board the train about stop, transfers, information search regarding "traffic conditions" and "cabin capacity ratio" were among the leading information searches for both men and women (Matsumoto and Hidaka, 2015).

Ibraeva and Figueira de Sousa (2014) posed the question whether the growing accessibility of information can induce a general modal shift towards transit use. While research is scarce regarding the use of information for planning transit trips and the linkage between seeking transit information and transit use (Farag and Lyons, 2012), studies show a positive relation between transit information and transit ridership. Hou and Chen (2013) reported that a survey revealed that 49.5% and 61.3% of travelers would have been willing to consider to adjust their departure time and mode according to pre-trip information. Brakewood et al. (2014) conducted a before-after survey for evaluating the impacts of real-time transit information on bus riders in Tampa (Florida), and found a significant change in the waiting time and the feelings associated with the waiting time, but not in the trip frequency or number of transfers. Dyrberg et al. (2015) found a significant relation between the role of information, ease of use of transit terminals and multi-modal route choice in the Copenhagen Region. Two recent studies provided a rigorous statistical analysis to investigate the impact of introducing real-time information on bus ridership, by estimating fixed effect models on longitudinal data, accounting for multiple factors such as level-of-service (LOS), gasoline prices, spatial and temporal effects. In Chicago, the monthly average weekday ridership of bus routes with real-time information was estimated to be 126 rides a day more than other routes, when controlling for all other factors (Tang and Thakuriah, 2012). In New-York, a similar effect was found, namely an average weekday increase of about 118 trips per route, attributable to providing real-time information (Brakewood et al., 2015).

The aforementioned studies used observed measurable indicators to support a positive relation between information provision as the external stimuli, and transit ridership as the outcome. In the case of transit information provision, observed measures are available in before-after studies when a new information system is introduced. However, research consistently shows that, even when there are no detectable changes in the system, subjective measures such as perceptions, social norms and perceived difficulties are significantly related to transit ridership (e.g., de Oña et al., 2013; Kaplan et al., 2014). Moreover, adding attitudinal constructs significantly improves the model fit (Spears et al., 2013). Tang and Thakuriah (2011) and Farag and Lyons (2012) focused on the role of travel attitudes. Tang and Thakuriah (2011) linked the willingness to increase transit use to previous experience with transit information, willingness to pay for transit information, and travel attitudes. Farag and Lyons (2012) focused on information use for long-distance trips, and found that information search is negatively related to routine travel and positively associated with less frequent use.

The contribution of this study to the current knowledge on transit information is four-fold. Firstly, this study is the first to apply the Extended Technology Acceptance Model (ETAM, Venkatesh and Davis, 2000) to investigate the role of information on transit use. The model provides a comprehensive and rigorous behavioral framework that considers the role of perceived information quality, perceived LOS, perceived usefulness of the transit system, perceived difficulties to use the system (i.e., perceived security, perceived cost), and perceived familiarity with the transit system. The hypothesized conceptual framework extends the classical ETAM because the information dimension is not explicitly included in the original ETAM framework.

Secondly, this study is the first to address the role of information use in non-routine travel at night and travel to unfamiliar places in addition to routine transit use at the intra-metropolitan level. On the one hand, when travel is habitual there is a strong link between travel goal and travel mode with habit reducing the responsiveness to information (Aarts et al., 1997; Farag and Lyons, 2012; Légal et al., 2016). On the other hand, because travelers mainly consider travel time and cost (Nielsen, 2000; Anderson et al., 2014), information is relevant even when transit use is frequent and routine (Şimşekoğlu et al., 2015). The current study is the first to show how information relates to both routine and non-routine transit use.

Thirdly, this study is the first to address students as an important market share of transit users. The attraction and retention of highly educated young people as transit users is important following the understanding that highly skilled young people in their twenties are not transit captives, but rather choose to lead a multi-modal lifestyle (Kuhnimhof et al., 2011, 2012). This study focuses on university students as the new generation of highly-educated young adults, which is rapidly increasing in Brazil and Colombia as well as in other countries and is characterized by high prospects of income