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Waiting time perceptions at transit stops and stations: Effects of basic amenities, gender, and security

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ABSTRACT

Waiting time in transit travel is often perceived negatively and high-amenity stops and stations are becoming increasingly popular as strategies for mitigating transit riders' aversion to waiting. However, beyond recent evidence that realtime transit arrival information reduces perceived waiting time, there is limited empirical evidence as to which other specific station and stop amenities can effectively influence user perceptions of waiting time. To address this knowledge gap, the authors conducted a passenger survey and video-recorded waiting passengers at different types of transit stops and stations to investigate differences between survey-reported waiting time and video-recorded actual waiting time. Results from the survey and video observations show that the reported wait time on average is about 1.21 times longer than the observed wait time. Regression analysis was employed to explain the variation in riders' reported waiting time as a function of their objectively observed waiting time, as well as station and stop amenities, weather, time of the day, personal demographics, and trip characteristics. Based on the regression results, most waits at stops with no amenities are perceived at least 1.3 times as long as they actually are. Basic amenities including benches and shelters significantly reduce perceived waiting times. Women waiting for more than 10 min in perceived insecure surroundings report waits as dramatically longer than they really are, and longer than do men in the same situation. The authors recommend a focus on providing basic amenities at stations and stops as broadly as possible in transit systems, and a particular focus on stops on low-frequency routes and in less safe areas for security measures.

1. Introduction

Travel time is an important predictor of mode choice—especially in the developed world, it can even outweigh monetary costs associated with modes, urban form, and personal socio-demographics (Cervero, 2002; Frank et al., 2008). Time, however, can be measured both objectively and subjectively. Objectively, "time is what clocks measure" (Caroll, 2011). Subjectively, time can be perceived and experienced differently based on events (Andersen and Grush, 2009). This brings in a contrasting viewpoint: time can be defined as a fundamental intellectual structure within which humans sequence and compare events (Allison, 2004). Individual perceptions of time can vary significantly from any externally measurable "objective" time (Block, 2014; Fraisse, 1984). Events experienced can either moderate or exacerbate these variations. For example,

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events occurring at regular intervals tend to produce underestimates of objective time, while events occurring at irregular intervals tend to produce overestimates (Yarmey, 2000). Intense experiences—positive or negative—are found to produce overestimates of duration (Angrilli et al., 1997; Ariely and Zakay, 2001; Droit-Volet et al., 2004; Effron et al., 2006). Tipples (2008) specifically found high-arousal experiences with negative emotionality produce greater overestimates of duration than high-arousal experiences with positive emotionality or emotionally neutral experiences. In a transportation context, increasing task complexity (e.g., route complexity) may increase perceived time (Carrion and Levinson, 2013; Parthasarathi et al., 2013).

When it comes to travel times of different modes, public transit faces an inherent disadvantage not shared by other modes: waiting time. Waiting time in transit travel tends to be perceived negatively. Time spent aboard transit vehicles (In-Vehicle Time, or IVT) is generally perceived as taking roughly as long as it really does (Wardman, 1998, 2004). Transit users, however, perceive waits for transit vehicles to arrive as significantly *longer* than they really are. This phenomenon is commonly expressed in terms of a waiting time multiplier—or the ratio of perceived waiting time to either actual waiting time or in-vehicle time (Wardman, 2014). Auto users similarly overweight stopped time at traffic lights and ramp meters (Levinson et al., 2004; Wu et al., 2009). Negative perceptions of waiting time have negative implications for users' overall feelings about their mode (St-Louis et al., 2014; Tyrinopoulos and Antoniou, 2008; Walle and Steenberghen, 2006), and present a significant obstacle to increasing the competitiveness of public transit, which is more environmental friendly than the private automobile mode (El-Geneidy et al., 2009; Watkins et al., 2011).

Transit agencies increasingly propose high-amenity transit stops and stations for mitigating the perceived burden of waiting time (Denver Union Station Project Authority, 2004; Metropolitan Council, 2012; Transit Planning Board, 2008). However, beyond the amenity of at-stop realtime arrival information (Brakewood et al., 2014, 2015a,b; Dziekan and Kottenhoff, 2007; Gooze et al., 2013; Watkins et al., 2011), existing research does not sufficiently explore how specific station and stop amenities (e.g., benches, shelters) can effectively reduce transit users' perceptions of waiting time. This missing knowledge is problematic for efforts to increase transit use: users' perceptions of transit service play an important role in determining mode choice (Walle and Steenberghen, 2006) and often cannot be determined from common system-level performance measures (Eboli and Mazzulla, 2011). To address this gap in transit planning knowledge, the authors conducted a unique study in the Minneapolis-St Paul (MSP) metropolitan region that combines an onboard survey with video observation to compare transit users' self-reported waiting time with external measures of their actual waiting time. The study takes a uniquely systematic perspective, including a wide range of stop and station types, transit modes, times of day and seasons. We then explain waiting time perceptions as a function of stop/station design and environment. We offer generalizable recommendations that can be applied from a light rail station to a curbside bus stop for reducing perceived waiting times.

2. Related studies

Transit users often perceive their waiting time as considerably longer than it actually is. Table 1 summarizes existing research assessing perceived waiting time in comparison with other travel time concepts. These studies found that a minute of perceived waiting time is equivalent to up to 2.5 min of in-vehicle time (IVT), and is equivalent to 1.2 min of actual wait time. For example, Wardman (2004) finds that a 2.5:1 ratio of waiting time to in-vehicle time (IVT) is more appropriate for schedule planning and ridership forecasting than the traditional British 2:1 assumption. Horowitz (1981) finds that any wait at all is perceived as equivalent to an extra 8.4 minutes' IVT in a 30 min trip and 13 minutes' IVT in a 45 min trip, and that a ten-minute wait is equivalent to an extra 18.9 or 23.2 min of IVT, respectively.

Waiting time ratios can differ significantly between stated preference (SP; in which participants are asked directly what value they place on waiting time) and revealed preference (RP; in which participants valuations of waiting time are observed from their behavior) data collection protocols: Abrantes and Wardman (2011) found a relatively low ratio of 1.43 among state preference designs, and a considerably higher ratio of 2.32 among revealed preference designs. Wallis et al. (2013) also pointed to a predominance of stated preference designs in interpreting their finding of a low waiting-time ratio of 1.25 in a review of six Australian and one New Zealand studies.

Table 1
Waiting time ratios in existing research.

Study	Ratio	Notes
Dziekan and Kottenhoff (2007)	1.2:1	Perceived vs. actual wait time before implementation of realtime info on high-frequency tram line; 1:1 after implementation
Watkins et al. (2011)	1.2:1	Perceived vs. actual time in at-stop survey after ~5 min wait time, without realtime transit information mobile app
Wardman (1998a)	1.2:1–1.7:1	Perceived waiting time vs. perceived IVT
Wallis et al. (2013)	1.3:1	Perceived waiting time vs. perceived IVT; meta-analysis of primarily SP designs
Wardman (2013)	1.5:1–1.9:1	Perceived waiting time vs. perceived IVT. Varies by trip distance and purpose
Abrantes and Wardman (2011)	1.4:1–2.3:1	Perceived waiting time vs. perceived IVT; ratio differs based on SP vs. RP design
Horowitz (1981)	1.9:1–2.3:1	Perceived waiting time vs. perceived IVT; found non-linear relationship by length of wait and trip
Wardman (2004)	2.5:1	Perceived waiting time vs. perceived IVT