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An empirical examination of U.S. travelers' intentions to use biometric e-gates in airports

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ABSTRACT

The current air travel security challenges call for innovative solutions. Among those solutions, biometric e-gates allow security agencies to allocate their resources efficiently while making travel more fluid in sensitive areas of airports. Using data from a nationwide sample of U.S. air travelers, this study constructed and validated empirically a conceptual model explaining travelers' intentions to use biometric e-gates in airports. It was found that performance and effort expectancy had the highest impacts, while privacy concerns had low impacts on intentions. Several implications for theory and practice are discussed.

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1. Introduction

The challenges associated with maintaining a secure air travel system are increasing in scope and importance. Due to a sustained business globalization, turbulent regional crises, the current security threats, and an expansion of air travel services to unprecedented levels, today's traveler flows are increasing (International Air Transport Association, 2016). Specifically, the proliferation of low cost air carriers and a clearer differentiation between the core and ancillary services offered by legacy carriers, the emergence of shared economy lodging/ground transportation business models at global scale (e.g., Airbnb, Uber), and the development of newer leisure destinations resulted in unprecedented leisure travel volumes. Moreover, the contemporary global business cycles and the development of attractive frequent traveler reward programs are creating new dynamics within business travel. In this context, the security organizations must allocate a limited amount of resources to safeguard the security of the increasingly interconnected global travel system and fend off threats (Wong and Brooks, 2015). Biometric systems play a critical role in this complex system of hardware, software, and business/administrative models, due to their ability to uniquely ascertain travelers' identity (Morosan, 2011).

Characterized by higher accuracy relative to rival systems (Jain et al., 2011), biometric systems have been successfully deployed in a variety of air travel and related border control settings (Farrell, 2016). Importantly, the accuracy of biometric systems relative to rival systems facilitated the development of biometric-based trusted traveler programs, which increased the efficiency of air travel and border control traveler processing (e.g., Global Entry, Nexus, Sentri, TSA PreCheck). The success of such programs is predicated upon: (1) the opportunity to redeploy resources to screen travelers with unknown backgrounds (i.e., higher risk) and thus realize substantial resource savings (Kosner, 2014), and (2) the benefits (e.g., convenience, processing speed) offered to enrolled (i.e., trusted) travelers (Morosan, 2012). The tremendous recent progress made in the development of biometric systems and the travelers' seeming acceptance of self-service technology facilitated the transcendence of legacy biometric systems into newer systems. Among those, biometric electronic gates (thereafter called "e-gates") represent one of the latest solutions for automatic air traveler processing when entering national territories, accessing secure areas, and boarding commercial flights (Caldwell, 2015).

E-gates are biometric systems based on single- or multi-modality biometric (e.g., face, fingerprint) and biographic (e.g., travel documents) information verification (Gohringer, 2015). Most e-gates have been deployed in border control settings, in airports in Europe and Asia, and the number of airports deploying e-gates is increasing (n.a., 2014). As the e-gate technology develops, the tasks addressed by e-gates are evolving as well. For example, adhering to contemporary newer "fast travel" initiatives, e-gates are currently being tested at Bengalore airport in India to ascertain if they can

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extend the task environment from predominantly border control to streamline traveler processing in domestic travel (Bengaluru Airport, 2015). While collaboration among critical stakeholders (e.g., airports, airlines, government security agencies) is necessary, e-gates could improve the end-to-end experience of travelers and the security of the overall travel system by including multiple tasks within the same travel experience, such as check-in, luggage services, or boarding (Farrell, 2016).

There is an increasing interest in understanding travelers' utilization of e-gates. The current trade literature unanimously points toward the increasing size and scope of e-gates deployment (Caldwell, 2015). However, there is no academic insight into the factors influencing intentions to use e-gates by travelers in voluntary settings, thus marking a critical research lacuna. While scholars continuously called for a systematic examination of adoption of biometric-based systems (Nelson, 2010), a number of academic articles offering initial insight into travelers' development of intentions to use general registered traveler systems have emerged (e.g., Morosan, 2011, 2012). However, the unique characteristics of e-gates (e.g., multi-modality biometrics, potential for broad deployment) and their unique role within the travel system make understanding the antecedents of intentions to use e-gates critical for two main reasons. First, e-gates represent one of the most viable security solutions to the challenge of identity verification of an increasing number of travelers (Farrell, 2016). Second, insight on how travelers use such systems can be incorporated into subsequent design of e-gates to facilitate use, which is especially important in a market that is poised to grow to $1.2 billion in annual revenues by 2020 (n.a., 2014).

The extensive information systems (IS) adoption (i.e., intentions to use, actual behavior) literature documents increasing calls from scholars to address another critical research lacuna: that of focusing predominantly on system perceptions as antecedents of intentions and actual behavior (Benbasat and Barki, 2007). To address this lacuna, scholars have strongly suggested designing IS theoretical models that include constructs better describing the nature of the personal processes involved in stimulating IS intentions (Limayem et al., 2007). To simultaneously address the critical research lacunae outlined above, this study developed and validated a conceptual model that explicated air travelers' intentions to use e-gates for boarding commercial flights. Based on theoretical foundations offered by the classic (Davis, 1989) and neo-classic technology adoption theory (Venkatesh et al., 2012), augmented with theoretical artifacts originating in social psychology theory (Dinev et al., 2013; Malhotra et al., 2004), this study followed two specific objectives: (1) to ascertain whether performance expectancy still remains the focal element in impacting intentions to use e-gates, and (2) to understand the roles of personal characteristics of travelers (e.g., privacy concerns, information sensitivity) in influencing their intentions to use e-gates.

2. Review of literature

2.1. Developing the core theoretical foundation

The rich literature on IS adoption converges toward a number of seminal theories, of which the Technology Acceptance Model (TAM) (Davis, 1989) remains, to date, the most popular (Schepers and Wetzels, 2007). However, despite its wide replication, the TAM has been criticized, especially for being too parsimonious (Venkatesh and Davis, 2000) and for not always being able to capture the full meaning of specific task-technology contexts (Benbasat and Barki, 2007). As a result, it was continuously augmented with constructs that are not native to the IS literature, but are good descriptors of the societal and individual contexts of IS adoption, thus creating a broader neo-classic theoretical base (Lian, 2015). Among the prominent neo-classic theories, the Unified Theory of Adoption and Use of Technology (UTAUT) and its newer version UTAUT2 (Venkatesh et al., 2012) stand out, as they are able to better capture the social context of IS intentions and behaviors. Given its broad empirical validation and strong theoretical base (Lin, 2007), the core UTAUT2 model was used in this study as the main theoretical base, retaining the core constructs of performance expectancy, effort expectancy, and intentions to use a technology that most critically reflect the task-technology fit (Venkatesh et al., 2012).

2.1.1. Performance expectancy

Performance expectancy reflects the extent to which an IS facilitates the completion of a task (Venkatesh and Bala, 2008). Representing a fundamental part of the core UTAUT2 theory, performance expectancy was often conceptualized by relying on attributes that are descriptive of the task-technology fit, which included efficiency, accuracy, and speed in the completion of a task (Venkatesh et al., 2012). The literature overwhelmingly provides support that IS characterized by high performance are likely to increase users' intentions to adopt such systems (Montazemi and Qahri-Saremi, 2015). E-gates are designed to accurately ascertain travelers' identities and expedite traveler processing, thus optimizing the security/revenue processes that are required in airports. This should facilitate increased use by travelers in order to make their processing more streamlined and contribute to a more secure air travel system. Accordingly, the following hypothesis was developed.

H1. There is a positive relationship between air travelers' e-gates performance expectancy and their intentions to use e-gates in airports.

2.1.2. Effort expectancy

Effort expectancy represents another core system perception, and reflects the amount of effort that is necessary for an individual to use a particular IS (Venkatesh et al., 2012). That is, the lower the users' effort in utilizing an IS, the higher the adoption of that IS (Venkatesh et al., 2012). Originating in the seminal TAM model, where it was named perceived ease of use, effort expectancy was retained as a core adoption construct even as the theories transcended and the name changed (Venkatesh and Bala, 2008). It was retained even through hypothesized links between ease of use and intentions were not always validated empirically (Baptista and Oliveira, 2015), or were found to be minor (Pascual-Miguel et al., 2015), thus rendering its role in stimulating intentions unclear. However, in studies regarding biometric system adoption in hotels/air travel using the TAM, it was found that effort expectancy (i.e., ease of use) directly impacted attitudes, and indirectly impacted intentions (Morosan, 2011). Moreover, designed as self-service technologies, e-gates are expected to be designed to facilitate fast learning by users and unaided use. Thus, travelers' effortless use of e-gates should translate into intentions to use (Slade et al., 2015). Accordingly, the following hypothesis was developed.

H2. There is a positive relationship between air travelers' e-gates effort expectancy and their intentions to use e-gates in airports.

Most studies based on the original TAM have documented a significant link between IS ease of use (e.g., effort expectancy) and usefulness (i.e., performance expectancy) Saber Chtourou and Souiden, 2010), even in situations in which usefulness was not found to be a significant predictor of attitudes/intentions (Lu et al., 2008). Although the UTAUT2 did not include such links, a

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