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Extending the two-stage information systems continuance model: incorporating UTAUT predictors and the role of context

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Abstract. *This study presents two extensions to the two-stage expectation-confirmation theory of information systems (IS) continuance. First, we expand the belief set from perceived usefulness in the original IS continuance model to include three additional predictors identified in the unified theory of acceptance and use of technology, namely effort expectancy, social influence and facilitating conditions. Second, we ground the IS continuance model in the context of transactional systems that involve transmission of personal and sensitive information and include trust as a key contextual belief in the model. To test the expanded IS continuance model, we conducted a longitudinal field study of 3159 Hong Kong citizens across two electronic government (e-government) technologies that enable citizens' access to government services. In general, the results support the expanded model that provides a rich understanding of the changes in the pre-usage beliefs and attitudes through the emergent constructs of disconfirmation and satisfaction, ultimately influencing IS continuance intention. Finally, we discuss the theoretical and practical implications of the expanded model.*

Keywords: expectation-confirmation theory, two-stage model of IS continuance, unified theory of acceptance and use of technology (UTAUT), e-government, technology adoption, technology acceptance model

INTRODUCTION

Users' post-adoption behaviours have emerged as a key topic in information systems (IS) research (see Bhattacherjee, 2001; Bhattacherjee & Premkumar, 2004). While various approaches can be used to encourage user adoption of an innovation, the long-term viability of a new IS hinges more on users' continuance behaviour than their initial adoption decisions. A key theory explaining continued IS usage is expectation-confirmation theory (ECT), also known as the expectation-confirmation model or expectation-disconfirmation theory (Bhattacherjee, 2001). Bhattacherjee & Premkumar (2004) proposed a two-stage model to study the change in cognitive beliefs (i.e. perceived usefulness and disconfirmation) and affect (i.e. satisfaction and attitude) during the course of IS usage. Related work on technology adoption and usage has presented an alternative theory, termed the unified theory of acceptance and use of technology (UTAUT; Venkatesh *et al*., 2003), to explain such ongoing usage. Although both theoretical perspectives help explain IS usage, there has been no systematic effort to integrate them to develop a more comprehensive view of the phenomenon, something that is important from a scientific standpoint (Greenwood, 1974; Gioia & Pitre, 1990). For instance, Wixom & Todd (2005) integrated two research streams – i.e. user satisfaction and technology acceptance – to provide a rich understanding relating features to IS usage.

We build on Bhattacherjee and Premkumar's (2004) model and contend that it can be extended to enhance our understanding of the post-adoption phenomenon. Specifically, we present two important extensions. Our first extension to Bhattacherjee and Premkumar's (2004) model is to expand the belief set beyond the sole belief in their model, i.e. perceived usefulness. Perceived usefulness is defined as the degree to which an individual believes that using the system will help him or her to attain gains in job performance (Bhattacherjee & Premkumar, 2004). It essentially captures users' cognitive expectations about the performance of the system. While the original ECT explains how performance-specific expectations about a product and the subsequent expectancy disconfirmation influence consumer satisfaction (Oliver, 1980), individuals' expectations about a product or a system are not necessarily restricted to the performance aspect. For example, although the expected performance of a system has been found to be important for influencing technology acceptance across a wide range of technologies and user populations (e.g. Thong, 1999; Venkatesh *et al*., 2003), it is not always the strongest predictor (see Venkatesh, 1999; Hong *et al*., 2006; Thong *et al*., 2006). This indicates that user expectations about a system can focus on many aspects, including ease of use (Venkatesh, 1999). User expectations about the different aspects of a system, similar to performance-specific expectations, are subject to change after usage experience. For example, user expectations about the effort required to use a system are subject to change after usage because such a belief can only be well formed based on hands-on experience (Venkatesh & Davis, 1996). Thus, the generalisability and broader applicability of the two-stage model to understand the changes in other usage-related beliefs and affect should be investigated (Bhattacherjee & Premkumar, 2004). Furthermore, the recognition of several important IS contexts where performance is not the sole concern of users – such as electronic government (e-government) (e.g. Moon & Norris, 2005), hedonic systems (e.g. Van der Heijden, 2004)

and collaboration systems (e.g. Sia *et al*., 2002) – makes it important to consider expanding the belief set.

Based on a synthesis of the research in this area, Venkatesh *et al*. (2003) have presented additional beliefs beyond perceived usefulness as being critical determinants of intention that can be used to augment ECT (see also Venkatesh & Goyal, 2010; Brown *et al*., forthcoming). UTAUT contains four core determinants of user acceptance and usage behaviour: performance expectancy, effort expectancy, social influence and facilitating conditions. Performance expectancy is synonymous with perceived usefulness and is the only belief included in Bhattacherjee & Premkumar (2004). To be consistent with Bhattacherjee & Premkumar (2004), in this paper, we use perceived usefulness to refer to users' perceptions about the performance aspect. Effort expectancy, social influence and facilitating conditions each capture user expectations about other important aspects related to system use – i.e. cost, interpersonal consideration and usage environment, respectively. The integrated belief set in UTAUT has been successfully applied to study the adoption of different technologies or services they enable such as online stock trading (Wang & Yang, 2005) and electronic marketplaces (Wang *et al*., 2006). However, UTAUT itself is lacking in that it does not provide for situations where disconfirmation of expectations about key beliefs may occur and, consequently, influence outcomes such as behavioural intention and use. Thus, incorporating the three additional predictors from UTAUT into ECT can contribute to a better understanding of IS usage compared with what would be obtained from UTAUT or ECT alone.

The second extension is to consider the IS usage context when theorising about the two-stage model of IS continuance. Bhattacherjee and Premkumar's (2004) model, like much prior technology adoption research, implicitly assumes the independence of context and technology. However, context does matter, and there is a strong interest in IS research in particular and business management research in general to give a richer treatment to context in theorising (e.g. Orlikowski & Iacono, 2001; Johns, 2006; Alvesson & Karreman, 2007). For example, Van der Heijden (2004) found that users value different things when using a hedonic vs. a utilitarian IS; likewise, Hong & Tam (2006) found that the determinants of consumer IS adoption are different from employee IS adoption. Thus, users do apply different decision-making processes depending on the context – i.e. the characteristics and usage contexts of the technology artefact (Orlikowski & Iacono, 2001).

One important context is systems that involve transmission of personal and sensitive information, such as business-to-consumer (B2C) electronic commerce (e-commerce) or government-to-citizen (G2C) e-government (e.g. online tax filing), where users are exposed to threats, such as credit card fraud and identity theft. With the increasing popularity of e-commerce, various types of online fraud, such as phishing and pharming, are growing rapidly (Cards International, 2007). Online consumers are more cautious about the security of their personal information on the internet than ever before (USA Today, 2006). There are rising concerns that while enjoying the benefits of e-government, citizens may be putting their privacy at risk as the information collected by governments is frequently sensitive (Yu, 2005). Thus, the context of e-government highlights the value of incorporating trust as a contextual belief in the two-stage IS continuance model. The importance of trust has been confirmed in prior IS research

(McKnight *et al*., 2002). Trust has been found to be vital in the adoption of online services such as e-commerce (e.g. Pavlou & Fygenson, 2006) and e-government (e.g. Carter & Bélanger, 2005).

Cumulatively, our two proposed extensions can make important contributions both in terms of integrating key theoretical perspectives in IS and incorporating the role of context that is critical to the advancement of science in general (Greenwood, 1974; Gioia & Pitre, 1990; Johns, 2006; Alvesson & Karreman, 2007). Specifically, while prior technology acceptance model (TAM)-based research has typically focused on static models and measured all constructs concurrently (Straub & Burton-Jones, 2007), incorporating the three additional predictors from UTAUT into the two-stage ECT can contribute to the understanding of temporal dynamics of other key adoption beliefs in addition to perceived usefulness. This extension can provide a more complete understanding of the changes in relative importance of various key beliefs at different stages of usage experience and therefore an implementation. Furthermore, an expanded belief set that includes contextual variables can provide opportunities for interventions to improve the design of IS (Hong *et al*., 2002). This extension is in line with recent calls for incorporating constructs relevant to the changing nature of emerging technologies to aid the design of interventions (Venkatesh *et al*., 2007; Venkatesh & Bala, 2008). Also, while prior TAM-based research has typically examined the influence of contextual variables on users' intentions to use a technology at the early adoption stage, incorporating contextual variables into a multistage model would deepen our understanding of the subsequent influences of these contextual variables at later periods.

The above discussion suggests that research examining an expanded belief set and specific contextual variables has the potential to contribute substantially to the two-stage model of IS continuance and advance our understanding of individuals' post-adoption behaviours. Given this backdrop, this paper's objectives are:

1 *to extend and contextualise the ECT in IS:* We incorporate four constructs – namely effort expectancy, social influence, facilitating conditions and trust – into Bhattacherjee and Premkumar's (2004) two-stage IS continuance model in the context of using an IS that requires transmission of personal and sensitive information; and
2 *to empirically validate our expanded model* using data collected in a large-scale longitudinal field study among users of two e-government technologies.

THEORY

ECT

ECT has been used in marketing research to study consumer satisfaction and post-purchase behaviour (e.g. Oliver, 1980). ECT suggests that consumers first form an initial expectation of a product or service prior to purchase. After the purchase decision and a period of use, consumers will form perceptions of the performance of the product or service. Next, consumers will compare the perceived performance with their initial expectations and determine the extent to which their

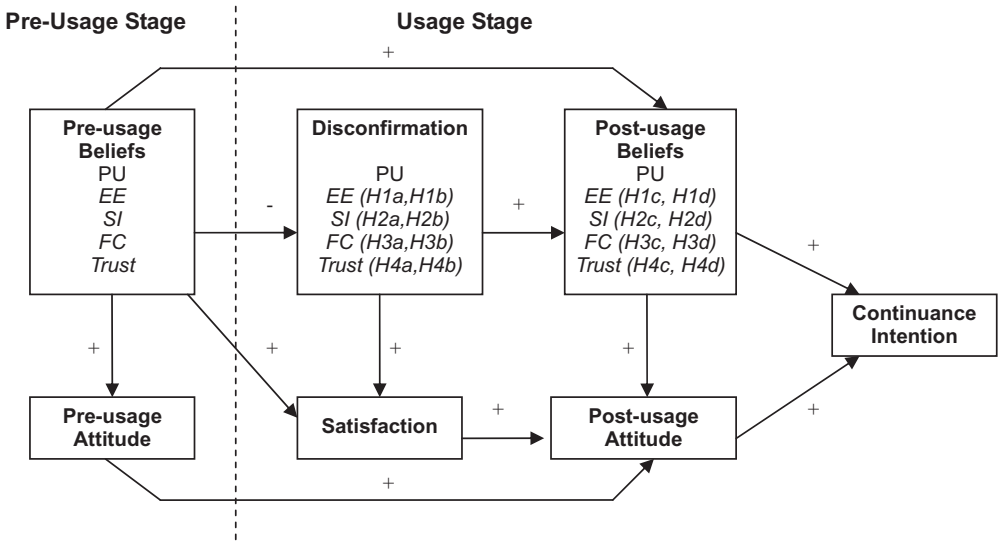

Figure 1. An expanded two-stage model of IS continuance. (1) The constructs added in our work are italicised. (2) PU, perceived usefulness; EE, effort expectancy; SI, social influence; FC, facilitating conditions.

expectations are confirmed. Finally, based on their expectations and confirmation levels, consumers form a satisfaction assessment that in turn affects their repurchase intention.

IS users' continuance decisions are similar to consumers' repurchase decisions, as both types of decisions (1) follow an initial decision; (2) are influenced by the usage experience; and (3) can potentially lead to ex post reversal of the initial decision (Bhattacherjee, 2001). ECT has been applied to study different problems in IS, such as IS continuance (Bhattacherjee, 2001), changes in users' beliefs and attitudes during the course of their IS usage (Bhattacherjee & Premkumar, 2004), post-usage satisfaction with application service providers (Susarla *et al*., 2003) and extended use of complex IS (Hsieh & Wang, 2007).

Based on ECT and prior IS research, Bhattacherjee (2001) proposed an expectation-confirmation model of IS continuance. The model posited that continuance intention was influenced by user satisfaction and post-acceptance usefulness perceptions, while user satisfaction was determined by confirmation of expectations from prior use and perceived usefulness. Furthermore, confirmation influenced perceived usefulness. Follow-up work by Bhattacherjee & Premkumar (2004) proposed a two-stage model of belief and attitude change, linking usage-related beliefs and attitudes in the pre-usage stage with those in the usage stage and positing disconfirmation and satisfaction as emergent constructs affecting post-usage beliefs and attitudes that in turn influence continuance intention (Figure 1). The disconfirmation construct is in essence the same as the confirmation construct in Bhattacherjee (2001). To avoid misunderstanding, we use positive/negative disconfirmation to refer to situations when things are better/worse than expected. This model makes it possible to capture how users' perceptions changed in the pre- and post-acceptance stages. However, similar to

Bhattacherjee (2001), Bhattacherjee & Premkumar (2004) incorporated perceived usefulness as the only usage-related belief.

UTAUT

Individual level technology adoption is one of the most mature streams of IS research (Venkatesh *et al*., 2007), with UTAUT representing a somewhat recent integrated view of the state of the knowledge (Venkatesh *et al*., 2003). UTAUT has been validated using data collected in the workplace at multiple time periods and shown to outperform the eight individual models it envelops. The generalisability of the beliefs in UTAUT has been demonstrated by a number of studies on the adoption of different technologies in both work and non-work contexts (e.g. Wang & Yang, 2005; Wang *et al*., 2006). In terms of interrelationships among the predictors in UTAUT, there is evidence of modest correlations among effort expectancy, social influence and facilitating conditions measured at different points in time, although these correlations are lower than the correlations of perceived usefulness (performance expectancy) over time (Venkatesh *et al*., 2003). This suggests that pre-usage beliefs may serve as anchors for post-usage beliefs as people tend to rely on their initial beliefs and early impressions in the formation of future beliefs. It is possible for these pre-usage beliefs to be disconfirmed, with such disconfirmation ultimately influencing future behaviour. However, the UTAUT beliefs, except for perceived usefulness (performance expectancy), have not been considered from an ECT perspective, and it is unclear how disconfirmation of these beliefs will affect satisfaction or continuance intention. For instance, although prior technology adoption research has measured these constructs at multiple points in time, there is little mention of disconfirmation and its consequences. Hence, it will be fruitful to examine disconfirmation involving UTAUT beliefs.

An expanded two-stage model of IS continuance

As noted earlier, we extend Bhattacherjee and Premkumar's (2004) model by incorporating effort expectancy, social influence and facilitating conditions from UTAUT, thus resulting in a more comprehensive set of beliefs in order to capture other important factors. We further extend their model by incorporating trust as a contextual belief to reflect users' increased concerns about privacy and security when using emerging technologies in contexts that require online transmission of personal and sensitive information. Bhattacherjee & Premkumar (2004) defined disconfirmation as the extent to which users' pre-usage expectation of IS usage is contravened during actual usage experience. Their model should be generalisable and applicable to other usage-related beliefs, with usage experience helping to resolve the uncertainty in these beliefs. Furthermore, as satisfaction refers to 'the summary psychological state resulting when the emotion surrounding disconfirmed expectations is coupled with the consumer's prior feelings about the consumption experience' (Oliver, 1981, p. 29), disconfirmation of any of these usage-related beliefs is expected to influence satisfaction. Specifically, satisfaction can be seen as 'an additive combination of the expectation level and the resulting disconfirmation' (Oliver, 1980, p. 461). Thus, the inclusion of these additional

beliefs in the two-stage IS continuance model will enable us to understand the change in cognitive beliefs during the course of IS usage from a broader perspective (see Figure 1). In the following sections, we present the hypotheses development.

Effort expectancy

Effort expectancy is defined as the degree of ease associated with the use of an IS (Venkatesh *et al*., 2003). Prior research suggests that the more complex an innovation, the lower its rate of adoption, especially among consumers (Venkatesh & Brown, 2001; Brown & Venkatesh, 2005). In previous technology adoption models, such as the TAM and the theory of planned behaviour (TPB), the role of effort expectancy on intentions is mediated by attitude (Venkatesh *et al*., 2003). Also, customers are more satisfied with self-service technologies that are easy to use (Meuter *et al*., 2000; Meuter *et al*., 2005).

While effort expectancy is a hurdle to the use of technology, perceptions of effort expectancy will only be well-formed after hands-on experience (Venkatesh & Davis, 1996). Venkatesh (2000) suggested that before hands-on experience, users' perceptions about ease of use would be anchored to various general computer beliefs about computer use. After direct experience, perceptions about ease of use would be adjusted to reflect various aspects of the experience. For instance, users may have certain expectations about the user-friendliness of a Web site. Through actual use of the Web site, users could assess its design and, in turn, confirm or disconfirm their expectations. Thus, during the course of system use, users' pre-usage effort expectancy will undergo a disconfirmation process and, in turn, influence satisfaction, post-usage effort expectancy and subsequently, post-usage attitude and continuance intention. Based on ECT, positive disconfirmation of effort expectancy is positively related to satisfaction because it implies realisation of the expected benefits (i.e. high degree of ease of use) of system use, and it will also elevate post-usage perceived benefits because users will adjust their perceptions in order to be more consistent with reality (Bhattacherjee, 2001). Furthermore, based on prior research (Venkatesh *et al*., 2003), effort expectancy has a positive influence on intention, in addition to its indirect effect via attitude. This is likely to hold true in continuance contexts because human tendencies for subconsciously pursuing instrumental behaviours are independent of the timing or stage of such behaviours (Bhattacherjee, 2001). In sum, we hypothesise:

H1a: Positive disconfirmation of effort expectancy has a positive influence on satisfaction.
H1b: Positive disconfirmation of effort expectancy has a positive influence on post-usage effort expectancy.
H1c: Post-usage effort expectancy has a positive influence on post-usage attitude.
H1d: Post-usage effort expectancy has a positive influence on continuance intention.

Social influence

Social influence is defined as the degree to which an individual perceives that important others believe he or she should use the new IS (Venkatesh *et al*., 2003). Its significance in influencing

the intention to use IS varies across studies (Venkatesh & Davis, 2000). On the one hand, social influence is expected to have a direct effect on intention, as suggested in TPB. On the other hand, based on Kelman's (1958) work on internalisation and identification, Venkatesh & Davis (2000) suggested that the effect of subjective norm may be mediated via attitude, although it was not tested in their paper. There is evidence that normative beliefs may influence attitude (Ryan, 1982; Schepers & Wetzels, 2007).

Bagozzi (1992) suggested that normative influence can be considered the result of integrating one's own expectations and feelings with significant others' perceived expectations and feelings with respect to the shared moral or social meaning of performing a prospective act. Based on these normative influences, if an individual was to perform a behaviour (e.g. use a system), the outcome of the behaviour could either confirm or disconfirm a priori expectations that, in turn, could strengthen or weaken the influences of the others who created the expectations. During system use, individuals may adjust their pre-usage social influence perceptions because of their observations of others' performance of the behaviour, the availability of new information and/or changes in friends' and peers' opinions. That is, user perceptions of social influence may be disconfirmed, and such disconfirmation will, in turn, influence satisfaction, post-usage social influence and subsequently, post-usage attitude and continuance intention. Based on the reasoning drawn from ECT (Bhattacherjee, 2001), positive disconfirmation of social influence is positively related to satisfaction and post-usage social influence because positive disconfirmation implies realisation of the expectations (i.e. existence of social norm) and elevates the corresponding post-usage perceptions. Furthermore, based on prior relevant research (Venkatesh *et al*., 2003), post-usage social influence will have a positive influence on continuance intention, in addition to its indirect effect via post-usage attitude. In sum, we hypothesise:

H2a: Positive disconfirmation of social influence has a positive influence on satisfaction.
H2b: Positive disconfirmation of social influence has a positive influence on post-usage social influence.
H2c: Post-usage social influence has a positive influence on post-usage attitude.
H2d: Post-usage social influence has a positive influence on continuance intention.

Facilitating conditions

Facilitating conditions is defined as the degree to which an individual believes that organisational and technical infrastructure exist to support use of the IS (Venkatesh *et al*., 2003). It is regarded as a belief related to one's control over the use of IS. Similar to social influence, facilitating conditions is often theorised to have a direct effect on intention and the use of IS (Venkatesh *et al*., 2003). However, previous studies suggest that the effects of different beliefs (i.e. attitudinal, normative and control) may crossover to influence other beliefs (Ryan, 1982). Based on dissonance theory (Festinger, 1957), it can be suggested that in situations where the facilitating conditions act as an inhibitor, individuals may adjust their attitudes negatively to be consistent with that situation. In contrast, given adequate resources,

individuals may be more likely to form positive attitudes as there are fewer reasons not to engage in the behaviour. Users will be able to assess the adequacy of resources (i.e. relevant knowledge and assistance) when they use the IS, thus their pre-usage beliefs associated with facilitating conditions may be disconfirmed. For example, if users have access to more resources and assistance (e.g. better availability of service terminals and online help) than expected in the usage stage, they will experience positive disconfirmation of facilitating conditions, which will, in turn, lead to higher satisfaction and post-usage facilitating conditions and, subsequently, post-usage attitude and continuance intention. Based on the reasoning drawn from ECT (Bhattacherjee, 2001), positive disconfirmation of facilitating conditions is positively related to satisfaction and post-usage facilitating conditions because positive disconfirmation implies realisation of the expectations (i.e. availability of supporting resources) and elevates the corresponding post-usage perception. Furthermore, based on prior relevant research (Venkatesh *et al*., 2003), post-usage facilitating conditions will have a positive influence on continuance intention, in addition to its indirect effect via post-usage attitude. In sum, we hypothesise:

H3a: Positive disconfirmation of facilitating conditions has a positive influence on satisfaction.
H3b: Positive disconfirmation of facilitating conditions has a positive influence on post-usage facilitating conditions.
H3c: Post-usage facilitating conditions have a positive influence on post-usage attitude.
H3d: Post-usage facilitating conditions have a positive influence on continuance intention.

Trust

Trust is defined as the belief that the trustee will act cooperatively to fulfil the trustor's expectations without exploiting its vulnerabilities (Pavlou & Fygenson, 2006). While trust has multiple conceptualisations (e.g. Mayer *et al*., 1995; McAllister, 1995), we conceptualise trust as a three-dimensional construct, comprising competence, benevolence and integrity (Mayer *et al*., 1995). This conceptualisation has been adopted in prior research in a context relevant to the current study, i.e. e-commerce (McKnight *et al*., 2002; Pavlou & Fygenson, 2006). Competence is the belief in the trustee's ability to do what the trustor expects. Benevolence is the belief that the trustee will act in the trustor's interests. Integrity is the belief that the trustee will be honest and keep its promise. Trust is critical in social exchange relationships and represents a common strategy for mitigating the uncertainty in unfamiliar settings (Blau, 1964). As Bradach & Eccles (1989) noted, trust is commonly used to reduce uncertainty or vulnerability in exchanges, particularly when people have limited knowledge or prior experiences. Trust is particularly critical in the context of IS where user privacy and security are at risk. For instance, when using e-commerce Web sites, consumers have to provide personal and sensitive information (e.g. credit card number, phone number) to vendors via the internet. As noted earlier, the increase in online fraud due to the exposure of personal and sensitive information makes trust a key construct in the context of B2C (e.g. online stores) and G2C (e.g. online tax filing) systems.

We expect trust to play an important role during both pre-usage and post-usage stages associated with these IS. First, trust has been found to affect the adoption of IS by creating positive attitudes, thus making it a key consideration in the development of different IS. Examples include IS that require online transmission of personal and sensitive information, such as e-commerce (Pavlou & Fygenson, 2006; Wang, 2008) and e-government (Carter & Bélanger, 2005), and IS that facilitate interorganisational information sharing such as supply chain management systems (Straub *et al*., 2004). Second, trust develops gradually as users interact with the IS and changes over time. Models that examine the longitudinal effects of trust on various behavioural outcomes are still rare. Thus, it is important to take into account the longitudinal nature of trust and examine the effects of trust over time. Third, with first-hand experience and repeated use of the IS during the usage stage, users can better assess its trustworthiness. For example, the use of online registration and a password for using government Web sites may make users feel safe when executing transactions. Such positive disconfirmation in the usage stage helps reinforce users' trust in the IS and leads to higher satisfaction and more positive attitudes towards the IS. Thus, we expect trust to be an important contextual belief that fits into Bhattacherjee and Premkumar's (2004) nomological network. We expect that disconfirmation of pre-usage trust will influence satisfaction, post-usage trust and, subsequently, post-usage attitude and continuance intention. Based on the reasoning drawn from ECT (Bhattacherjee, 2001), positive disconfirmation of trust is positively related to satisfaction and post-usage trust because positive disconfirmation implies realisation of the expectations (i.e. trustworthiness of the trustee) and elevates the corresponding post-usage perception. Furthermore, based on prior relevant research (Carter & Bélanger, 2005; Pavlou & Fygenson, 2006), post-usage trust will have a positive influence on continuance intention, in addition to its indirect effect via post-usage attitude. In sum, we hypothesise:

H4a: Positive disconfirmation of trust has a positive influence on satisfaction.
H4b: Positive disconfirmation of trust has a positive influence on post-usage trust.
H4c: Post-usage trust has a positive influence on post-usage attitude.
H4d: Post-usage trust has a positive influence on continuance intention.

METHOD

E-government technologies

The context for this study was adoption and use of e-government in Hong Kong. We studied two e-government technologies: Smart Identity Card (SmartID) – an identity card embedded with a computer chip storing personal information of the owner – and the e-government Web site (GovWeb), which represent offline and online technologies, respectively, that require sharing and transmission of personal and sensitive information by citizens. SmartID facilitates citizens' use of a variety of electronic public services, such as self-service library checkout and automatic immigration clearance services, and GovWeb delivers information about the government to citizens and provides them with the means to conduct transactions with

government agencies, such as booking appointments and filing taxes. Furthermore, the use of these two technologies was voluntary – instead of using the electronic services, citizens could physically check out books at the library or file their taxes using a paper-based method.

Sample and procedure

The sampling frame was visitors to an e-government portal in Hong Kong. At the time of our study, the Hong Kong government had recently launched GovWeb. Soon after, the government began replacing the identity cards of citizens with SmartIDs. This presented us with an opportunity to conduct a natural longitudinal field study on citizens' perceptions of these two e-government technologies. In the first stage of the study, the government placed advertisements in the press and on TV publicising the benefits of SmartID and inviting citizens to visit GovWeb to book appointments for replacement of their identity cards. On the main Web page of GovWeb, there was a banner advertisement about SmartID. When citizens clicked this banner, they would be taken to a Web page with detailed information about SmartID and how to use it. After perusing the information about SmartID, citizens could then book an appointment with the immigration department to replace their old identity card; in this process, they had to provide personal information, e.g. name, telephone number and identity card number. On completing the appointment booking, they were invited to participate in an online survey. When citizens clicked on the survey banner, they were directed randomly to a questionnaire that focused on one of the target e-government technologies that captured the pre-usage perceptions of the respondents. In the case of citizens who completed the SmartID questionnaire, they had just formed their pre-usage perceptions about the use of SmartID based on the information provided on the Web site; they were not users of SmartIDs yet as they had not yet even gone for their appointments to replace their identity cards. In the case of citizens who completed the GovWeb questionnaire, they had just formed their pre-usage perceptions about the use of GovWeb after very limited exposure in using the Web site to book an appointment; this could be viewed as a trial use of GovWeb to access transactional government services, similar to the data collection methodology utilised in prior longitudinal adoption studies (e.g. Venkatesh *et al*., 2003; Bhattacherjee & Premkumar, 2004).

Four months after the respondents completed the first stage survey, they were invited via email to participate in a follow-up survey to indicate their post-usage perceptions and IS continuance intention. We sent an email reminder to non-respondents if they had not completed the second survey after 2 weeks. Incentives were offered for participation in both stages of the survey in the form of an entry in a drawing to win popular consumer products, such as PDAs and MP3 players.

Consistent with Bhattacherjee & Premkumar (2004), we measured constructs at two points in time. Our focal six constructs were perceived usefulness, effort expectancy, social influence, facilitating conditions, trust and attitude. In the first stage survey, we measured pre-usage perceptions of the six constructs. In the second stage survey, we measured disconfirmation of the various beliefs, satisfaction, post-usage perceptions of the six constructs and IS continuance intention. In the first stage survey, 10 368 responses were received: 4847 for the

SmartID survey and 5521 for the GovWeb survey. In the second stage survey, 4670 respondents from the first stage survey responded: 2270 for the SmartID survey and 2400 for the GovWeb survey. Among these respondents, 1263 (56%) had used SmartID and 1896 (79%) had used GovWeb during the intervening 4 months. Of these 3159 relevant respondents, 1606 (51%) were women. Non-response bias was assessed by comparing the demographic characteristics of respondents and non-respondents with the second stage survey, and no significant differences were found between the two groups. Similarly, no demographic differences were found between early and late respondents.

A potential threat to the validity of surveys is common method bias (Podsakoff *et al*., 2003). Consistent with the approach of Premkumar & Bhattacherjee (2008), we conducted the Harman's one-factor test to evaluate the possibility of common method bias. In this test, if a substantial amount of common method variance (CMV) exists, a single factor will emerge from the factor analysis or one general factor will account for the majority of the covariance in the independent and dependent variables (Podsakoff *et al*., 2003). Following Premkumar & Bhattacherjee (2008), we conducted two Harman's tests separately for constructs measured at time 1 and time 2. In the first test, all items measuring pre-usage beliefs and attitude at time 1 were combined into a single-factor analysis. For the SmartID sample, the first factor accounted for 28% of the variance. For the GovWeb sample, the first factor accounted for 26% of the variance. In the second test, all items measuring disconfirmation, post-usage beliefs, satisfaction, attitude and continuance intention were combined into a single-factor analysis. For the SmartID sample, the first factor accounted for 23% of the variance. For the GovWeb sample, the first factor accounted for 22% of the variance. In sum, these results indicate that the first factor does not account for the majority of the covariance in any of the tests, suggesting that common method bias is not a concern in our data set. As an additional test for CMV, we employed the marker variable technique (Lindell & Whitney, 2001; Malhotra *et al*., 2006). We discuss this in the next section.

Measurement

We used previously validated scales for all constructs and modified them to fit the context of SmartID and GovWeb (see Appendix). Perceived usefulness, effort expectancy, social influence, facilitating conditions and attitude were measured with three items each that were adapted from Bhattacherjee & Premkumar (2004) and Venkatesh *et al*. (2003). Trust was measured using three items adapted from McKnight *et al*. (2002), each measuring one of the three dimensions of trust, i.e. competence, benevolence and integrity. While these three dimensions have traditionally been applied to trust in humans, researchers (e.g. McKnight *et al*., 2002; Chen & Dhillon, 2003) have adapted these trust dimensions to reflect trust in non-humans (e.g. Web sites and e-commerce). We measured satisfaction, IS continuance intention and disconfirmation as it related to perceived usefulness, effort expectancy, social influence, facilitating conditions and trust with three items each, also adapted from Bhattacherjee & Premkumar (2004) and Venkatesh *et al*. (2003). The items were translated to Chinese

and back-translated to English by professional translators. Minor wording discrepancies were discussed and resolved. The questionnaire was administered in Chinese, the main lingua franca in Hong Kong.

RESULTS

Instrument validation

Using partial least squares (PLS), we conducted confirmatory factor analysis (CFA) on each sample separately. Significance testing was performed using the bootstrapping method with 500 subsamples. Results of the CFA show that the factor loadings for all items were significant and exceeded 0.70, thus demonstrating internal consistency. The results observed here are consistent with those reported in previous studies (e.g. Venkatesh *et al*., 2003; Bhattacherjee & Premkumar, 2004). The measurement model produced a clean factor structure and was consistent with much prior research. Because of this consistency and space constraints, the detailed results are not shown here.

Reliability and convergent validity were estimated using composite reliability and average variance extracted (AVE) (see Table 1). The composite reliabilities of all constructs exceeded 0.80. The AVE for each construct was greater than the recommended 0.50 level, which meant that more than one-half of the variance observed in the items was explained by their hypothesised constructs. To examine discriminant validity, we compared the correlations between constructs with the AVE of the individual constructs. For both samples, the correlations between variables were all below the square root of AVE of either construct. In sum, the results provided evidence of reliability and validity.

Comparing pre-usage and post-usage data

The first step in understanding disconfirmation in this context is to compare the data over time. We compared the respondents' perceived usefulness, effort expectancy, social influence, facilitating conditions, trust and attitude at time t_1 (first stage survey) with the corresponding measures at t_2 (second stage survey). These results are presented in Table 2. In both the SmartID sample and GovWeb sample, the correlations between pre-usage and post-usage beliefs (except social influence) and attitude were moderate (ranged from 0.32 to 0.41), suggesting that users' expectations changed to some extent. Furthermore, all measures taken post-usage were lower than the pre-usage measures, suggesting that it was likely that the users' perceptions were negatively disconfirmed after usage. Social influence was highly correlated at 0.71, although the post-usage measure was still lower than the pre-usage measure, suggesting that it was the most stable over time. These observations are consistent with the general tenets of Bhattacherjee and Premkumar's (2004) model that users' cognitions about IS usage change over time.

Table 1. Descriptive statistics and correlations

	SmartID				GovWeb				Correlations				
	M	SD	CR	AVE	M	SD	CR	AVE	PU1	EE1	SI1	FC1	T1
PU1	5.39	1.14	0.96	0.89	5.46	1.08	0.96	0.90		0.70***	0.43***	0.68***	0.66***
EE1	5.25	1.14	0.95	0.87	5.33	1.10	0.95	0.85	0.75***		0.44***	0.78***	0.61***
SI1	4.63	1.20	0.90	0.80	4.66	1.19	0.91	0.79	0.53***	0.53***		0.56***	0.40***
FC1	5.10	1.09	0.89	0.73	5.11	1.01	0.88	0.71	0.70***	0.80***	0.57***		0.62***
T1	5.30	1.09	0.93	0.81	5.42	1.11	0.94	0.83	0.71***	0.65***	0.51***	0.67***	
ATT1	5.61	1.18	0.93	0.81	5.75	1.11	0.94	0.85	0.62***	0.56***	0.45***	0.55***	0.65***
DPU2	3.23	0.98	0.96	0.89	3.33	0.92	0.95	0.86	–0.24***	–0.20***	–0.19***	–0.22***	–0.22***
DEE2	3.34	1.03	0.95	0.85	3.39	0.92	0.93	0.81	–0.21***	–0.21***	–0.16***	–0.21***	–0.20***
DSI2	4.04	0.38	0.91	0.78	4.05	0.37	0.88	0.75	0.13***	0.10***	0.21***	0.08**	0.12***
DFC2	3.59	0.92	0.93	0.81	3.45	0.89	0.91	0.77	–0.21***	–0.17***	–0.21***	–0.22***	–0.21***
DT2	3.50	0.88	0.92	0.80	3.45	0.82	0.91	0.77	–0.26***	–0.22***	–0.24***	–0.24***	–0.24***
SAT2	4.95	0.98	0.96	0.90	4.74	0.88	0.95	0.87	0.29***	0.25***	0.20***	0.28***	0.28***
PU2	4.96	1.02	0.96	0.90	5.04	0.96	0.95	0.88	0.32***	0.29***	0.19***	0.29***	0.28***
EE2	4.90	1.06	0.95	0.87	4.98	1.00	0.94	0.84	0.30***	0.34***	0.20***	0.32***	0.25***
SI2	4.48	1.22	0.90	0.82	4.47	1.17	0.88	0.80	0.42***	0.42***	0.71***	0.50***	0.45***
FC2	4.58	0.99	0.91	0.77	4.75	0.89	0.87	0.69	0.28***	0.31***	0.24***	0.32***	0.26***
T2	4.70	0.95	0.94	0.84	4.75	0.91	0.92	0.79	0.31***	0.28***	0.24***	0.30***	0.32***
ATT2	5.24	1.01	0.97	0.90	5.25	1.00	0.96	0.89	0.38***	0.33***	0.22***	0.36***	0.35***
INT2	5.43	1.10	0.98	0.93	5.55	1.05	0.97	0.92	0.31***	0.31***	0.18***	0.33***	0.32***

	Correlations													
	ATT1	DPU2	DEE2	DSI2	DFC2	DT2	SAT2	PU2	EE2	SI2	FC2	T2	ATT2	INT2
PU1	0.69***	–0.33***	–0.30***	0.10***	–0.29***	–0.29***	0.33***	0.37***	0.34***	0.33***	0.33***	0.33***	0.36***	0.38***
EE1	0.60***	–0.33***	–0.33***	0.08***	–0.29***	–0.29***	0.33***	0.34***	0.40***	0.37***	0.37***	0.31***	0.33***	0.33***
SI1	0.38***	–0.24***	–0.25***	0.12***	–0.26***	–0.25***	0.27***	0.25***	0.27***	0.71***	0.27***	0.28***	0.23***	0.22***
FC1	0.60***	–0.33***	–0.34***	0.06**	–0.32***	–0.31***	0.35***	0.35***	0.39***	0.52***	0.38***	0.35***	0.34***	0.35***
T1	0.67***	–0.33***	–0.30***	0.11***	–0.31***	–0.31***	0.36***	0.36***	0.35***	0.31***	0.35***	0.41***	0.37***	0.36***
ATT1		0.28***	0.25***	–0.11***	0.25***	0.24***	0.31***	0.34***	0.30***	0.27***	0.27***	0.30***	0.38***	0.39***
DPU2	0.19***		0.75***	–0.11***	0.71***	0.72***	0.69***	0.68***	0.63***	0.16***	0.60***	0.62***	0.59***	0.56***
DEE2	0.17***	0.73***		–0.09***	0.72***	0.69***	0.65***	0.62***	0.66***	0.20***	0.61***	0.60***	0.56***	0.51***
DSI2	–0.12***	–0.02	–0.03		–0.09***	–0.09***	–0.11***	–0.07***	–0.09***	0.31***	–0.09***	–0.10***	–0.12***	–0.11***
DFC2	0.16***	0.61***	0.70***	–0.03		0.72***	0.68***	0.60***	0.59***	0.20***	0.62***	0.61***	0.54***	0.48***
DT2	0.20***	0.67***	0.65***	–0.07*	0.71***		0.71***	0.64***	0.60***	0.20***	0.63***	0.71***	0.59***	0.53***
SAT2	0.25***	0.67***	0.63***	–0.02	0.57***	0.66***		0.70***	0.66***	0.18***	0.67***	0.69***	0.67***	0.59***
PU2	0.25***	0.71***	0.65***	–0.03	0.58***	0.65***	0.72***		0.76***	0.16***	0.69***	0.69***	0.74***	0.70***
EE2	0.26***	0.58***	0.67***	–0.02	0.58***	0.58***	0.65***	0.77***		0.18***	0.77***	0.67***	0.69***	0.65***
SI2	0.36***	0.16***	0.13***	0.29***	0.22***	0.19***	0.17***	0.15***	0.16***		0.21***	0.20***	0.11***	0.12***
FC2	0.24***	0.56***	0.62***	0.00	0.66***	0.61***	0.60***	0.70***	0.79***	0.23***		0.73***	0.67***	0.61***
T2	0.27***	0.62***	0.61***	–0.07*	0.61***	0.70***	0.67***	0.72***	0.67***	0.20***	0.72***		0.74***	0.62***
ATT2	0.33***	0.58***	0.55***	–0.05	0.51***	0.56***	0.70***	0.73***	0.67***	0.17***	0.59***	0.71***		0.76***
INT2	0.30***	0.59***	0.56***	–0.03	0.44***	0.53***	0.66***	0.71***	0.66***	0.16***	0.56***	0.64***	0.76***	

*$p < 0.05$.

**$p < 0.01$.

***$p < 0.001$.

The correlations below the diagonal are for SmartID sample, and the correlations above the diagonal are for GovWeb sample.

M, mean; SD, standard deviation; CR, composite reliability; AVE, average variance extracted; PU1, perceived usefulness at t_1; EE1, effort expectancy at t_1; SI1, social influence at t_1; FC1, facilitating conditions at t_1; T1, trust at t_1; ATT1, attitude at t_1; DPU2, disconfirmation (PU) at t_2; DEE2, disconfirmation (EE) at t_2; DSI2, disconfirmation (SI) at t_2; DFC2, disconfirmation (FC) at t_2; DT2, disconfirmation (trust) at t_2; SAT2, satisfaction at t_2; PU2, perceived usefulness at t_2; EE2, effort expectancy at t_2; SI2, social influence at t_2; FC2, facilitating conditions at t_2; T2, trust at t_2; ATT2, attitude at t_2; INT2, IS continuance intention at t_2.

Table 2. Construct comparison between first stage and second stage surveys

		t_1		t_2 (4 months later)		Difference between t_1 and t_2			
	Corr	Mean	SD	Mean	SD	Mean	SD	t-Statistic	*p*-Value
SmartID sample									
Perceived usefulness	0.32***	5.39	1.14	4.96	1.02	0.43	1.26	12.01	0.0000
Effort expectancy	0.34***	5.25	1.14	4.90	1.06	0.35	1.26	9.78	0.0000
Social influence	0.71***	4.63	1.20	4.48	1.22	0.15	0.92	5.84	0.0000
Facilitating conditions	0.32***	5.10	1.09	4.58	0.99	0.52	1.22	15.33	0.0000
Trust	0.32***	5.30	1.09	4.70	0.95	0.60	1.19	17.74	0.0000
Attitude	0.33***	5.61	1.18	5.24	1.01	0.36	1.27	10.18	0.0000
GovWeb sample									
Perceived usefulness	0.37***	5.46	1.08	5.04	0.96	0.42	1.15	15.93	0.0000
Effort expectancy	0.40***	5.33	1.00	4.98	1.10	0.35	1.15	13.29	0.0000
Social influence	0.71***	4.66	1.19	4.47	1.17	0.19	0.89	9.12	0.0000
Facilitating conditions	0.38***	5.11	1.01	4.75	0.89	0.37	1.06	15.03	0.0000
Trust	0.41***	5.42	1.11	4.75	0.91	0.66	1.11	25.95	0.0000
Attitude	0.38***	5.75	1.11	5.25	1.00	0.49	1.18	18.22	0.0000

Corr, correlations between pre- and post-usage beliefs; SD, standard deviation.
***$p < 0.001$.

Model testing

We used PLS to test our model on data from the two samples. As the sample sizes were quite large, some small, non-meaningful effects could become significant. Hence, we examined the magnitude of path coefficients, in addition to their statistical significance (e.g. Sheridan & Vredenburgh, 1979) in drawing our conclusions. Results of these analyses are presented in Figure 2.

The two sets of results were largely consistent. First, in the pre-usage stage (t_1), trust ($\beta = 0.38$ for SmartID; $\beta = 0.34$ for GovWeb) and perceived usefulness ($\beta = 0.25$ for SmartID; $\beta = 0.35$ for GovWeb) were significant determinants of attitude with $R^2 = 0.48$ for SmartID and $R^2 = 0.57$ for GovWeb. Second, in the post-usage stage (t_2), disconfirmation of most constructs, i.e. perceived usefulness, effort expectancy, facilitating conditions and trust, was negatively correlated with the corresponding pre-usage measures taken at t_1, suggesting that these constructs were indeed negatively disconfirmed post-usage; specifically, the higher the initial level of these beliefs, the more likely they were to be negatively disconfirmed. Consistent with this, all the means for disconfirmation measures (except social influence) were somewhat below the neutral point of 4 (see M columns in Table 1). The disconfirmation of social influence, however, had a low but positive correlation with pre-usage social influence, suggesting that perhaps the normative pressure increased slightly over time, with the disconfirmation measure confirming this as its mean was marginally above the neutral point. Third, the usage-related beliefs at t_2 were mainly determined by the disconfirmation at t_2, and prior beliefs at t_1 were much less significant. The positive path coefficients of these various disconfirmation beliefs

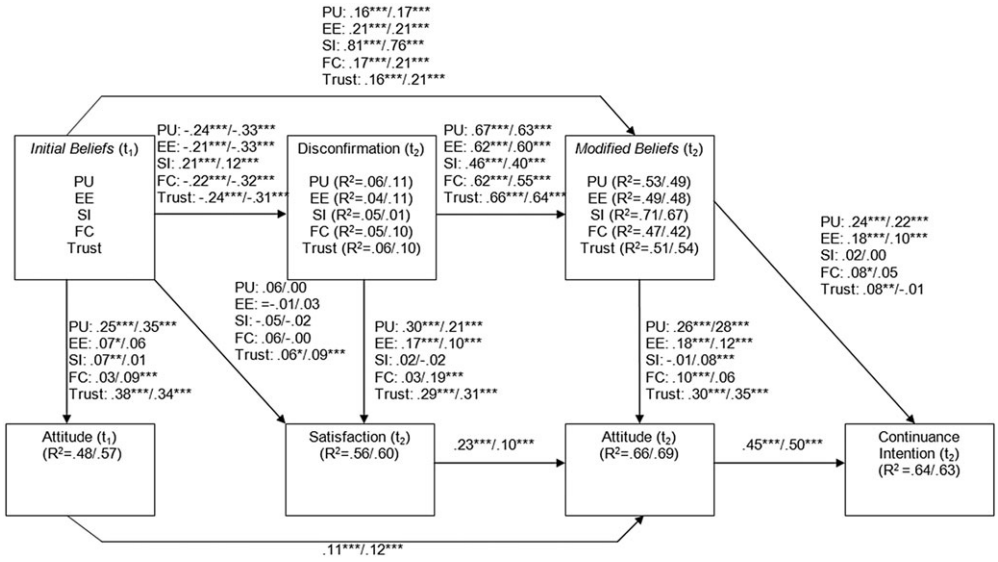

Figure 2. Results. Coefficients of constructs in two samples (SmartID/GovWeb) are shown along paths. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$. PU, perceived usefulness; EE, effort expectancy; SI, social influence; FC, facilitating conditions.

indicate that positive disconfirmation of usage-related beliefs will have a positive influence on the usage-related beliefs at t_2. Social influence was the exception here as well; it was the pre-usage social influence and not the disconfirmation that was a stronger predictor of post-usage social influence. This pattern was likely due to the stability of social influence over time as evidenced by the high correlation between pre- and post-usage social influence. Fourth, satisfaction at t_2 ($R^2 = 0.56$ for SmartID; $R^2 = 0.60$ for GovWeb) was explained mainly by the disconfirmation of usage-related beliefs at t_2 but not prior beliefs at t_1. While most users' perceptions were negatively disconfirmed after usage in our sample (i.e. the means of disconfirmation beliefs are below 4, except social influence), the positive path coefficients of these disconfirmation beliefs indicate that positive disconfirmation of usage-related beliefs lead to higher satisfaction. Fifth, post-usage attitude at t_2 ($R^2 = 0.66$ for SmartID; $R^2 = 0.69$ for GovWeb) was explained jointly by satisfaction and post-usage beliefs. Finally, IS continuance intention ($R^2 = 0.64$ for SmartID; $R^2 = 0.63$ for GovWeb) was explained primarily by post-usage attitude, followed by perceived usefulness and effort expectancy. In general, the results from the two samples confirmed the majority of our hypotheses regarding effort expectancy, social influence, facilitating conditions and trust; only H2a and H2d were not supported in both samples.

To further validate our results, we employed the marker variable technique (Lindell & Whitney, 2001; Malhotra *et al.*, 2006) to account for common method bias and then test the hypotheses based on the corrected correlations. Specifically, we chose the second-smallest positive correlation among the constructs measured in the same time period (0.15 for SmartID

sample; 0.12 for GovWeb sample) as a conservative estimate of CMV to produce the CMV-adjusted correlation matrix (Lindell & Whitney, 2001). Following Malhotra *et al*. (2006), we produced a CMV-adjusted correlation matrix and then used it to estimate CMV-adjusted path coefficients and explained variance. The results show that after controlling for CMV effects, the explained variances in the dependent variables decrease, but the drop is not substantial (i.e. 4–8%). The path coefficients are mostly consistent with those without that were found without the CMV adjustment. These results demonstrate the robustness and the validity of our findings and limit the threat of common method bias.

DISCUSSION

This work extended Bhattacherjee and Premkumar's (2004) two-stage ECT by incorporating three key predictors from UTAUT, namely effort expectancy, facilitating conditions and social influence, and a key contextual belief, trust. The results demonstrated that additional UTAUT constructs beyond perceived usefulness (performance expectancy) are important in explaining the intervening variables – i.e. disconfirmation, attitude and satisfaction – and ultimately, IS continuance intention. The results further demonstrated the key role of trust on individuals' pre- and post-usage attitudes and on satisfaction in the IS usage context where transmission of personal and sensitive information is required. Finally, our findings provide evidence of the persistent influence of perceived usefulness and the role of the emergent constructs of disconfirmation and satisfaction in shaping changes in beliefs and attitude, thus providing further empirical support with large samples for the work of Bhattacherjee & Premkumar (2004). Such a replication with a theoretically motivated extension is important as it helps examine whether theories or models that are predictive in one context will be as effective in another (Johns, 2006).

Theoretical contributions

This work makes important contributions to several streams of IS research. The broadest and most important contribution of this work is integrating different theoretical perspectives and incorporating the role of context. This work integrates ECT and UTAUT, two dominant theories used in IS research, to predict ICT adoption. Specifically, this work extends prior research that examines only performance-specific expectations (Oliver, 1980; Bhattacherjee, 2001; Bhattacherjee & Premkumar, 2004) by incorporating key predictors in UTAUT to capture other important user expectations associated with system use. We thus create a comprehensive view of the underlying phenomenon by developing a model that unifies two dominant theories whose tenets have thus far been quite different. Such integration is a key contribution and way to advance science (see Greenwood, 1974; Gioia & Pitre, 1990).

We investigated IS continuance intention in the context of e-government technologies and incorporated a key contextual belief – i.e. trust – in the expanded IS continuance model. By doing so, we respond to the call in IS research to embrace context when investigating

individuals' use of technology artefacts (see Orlikowski & Iacono, 2001). Such sensitivity to the context is also, especially recently, considered to be important in theory development, advancement and contribution (see Johns, 2006; Alvesson & Karreman, 2007). Our results demonstrate that the context can be important for identifying relevant variables. In this case, because personal and sensitive information is exchanged over the internet, trust was identified as a critical construct. In other contexts, such as those associated with convenience (e.g. services involving online payments), alternative constructs may need to be considered as predictors. We observed this somewhat through the subtle differences across the two types of e-government technologies. Thus, our results highlight the need to consider context-relevant variables when designing research to study technology adoption and use.

A few differences were observed in the formation of post-usage satisfaction, attitude and continuance intention between the two samples, which might be caused by the differences in usage context of the two types of e-government technologies. First, while disconfirmation in both trust and perceived usefulness was significant in predicting satisfaction in the two technologies, the effect of disconfirmation of effort expectancy was more important for SmartID, and disconfirmation of facilitating conditions was more important for GovWeb. This suggests that citizens may look for different characteristics (e.g. easy-to-use functionalities or adequate assistance) when using technologies in different contexts (offline vs. online); they would prefer asking for assistance from government officers when using offline e-government technology (i.e. SmartID) and relying on the online self-explanatory instructions to solve their problems when using online e-government technology (i.e. GovWeb). Second, while attitude towards using SmartID at t_2 was explained by satisfaction, trust, perceived usefulness and effort expectancy, attitude towards using GovWeb was largely explained by trust and perceived usefulness. This further supported our expectation that the usage context was important to understanding the changes in cognitions and attitude. As SmartID is a technology that supports multiple functionalities, citizens are more likely to consider a richer set of beliefs when deciding to use it. In contrast, as GovWeb is a technology for delivery of government information and coordination of e-government services, citizens may be concerned about its trustworthiness and performance only, with satisfaction having a limited impact on future use. Finally, effort expectancy had a stronger effect on IS continuance intention for SmartID than it did for GovWeb. This is consistent with our observation on the formation of post-usage satisfaction and attitude. That effort expectancy had a weaker effect for GovWeb is not surprising in that the technology fits the profile of technologies with which citizens are likely to have considerable familiarity, i.e. Web-based technologies, and effort expectancy thus becomes less important over time (Venkatesh *et al*., 2003). In the case of SmartID, which is a relatively new technology, citizens likely need more time to comprehend how to use it, thus making effort expectancy salient even in the longer run. These differences across the two settings further highlight the importance of accounting for context in IS research.

In sum, this work demonstrates the importance of ECT in IS research, increases our understanding of post-adoption factors and behaviours, contributes to the growing body of research on technology adoption and contributes to research emphasising the importance of context in IS studies. In general, this work demonstrates that other adoption beliefs (e.g. effort

expectancy, facilitating conditions and trust), like perceived usefulness, will undergo a disconfirmation process and, in turn, determine the corresponding post-usage beliefs, satisfaction and, subsequently, post-usage attitude and continuance intention. This opens up the possibility to incorporate additional beliefs relevant to other technologies into the two-stage IS continuance model, thus allowing the examination of users' adoption of emerging technologies and their post-adoption behaviours in a multistage setting. This work also complements prior studies on technology adoption by providing a possible explanation based on the ECT for the correlations of key adoption beliefs measured at different points in time (e.g. Venkatesh *et al*., 2003). In particular, our results show that the beliefs in the expanded belief set differ in their influence on satisfaction, post-usage attitude and continuance intention. In the current study, while all beliefs in the belief set (except social influence) undergo a disconfirmation process and influence the corresponding post-usage beliefs and satisfaction, only perceived usefulness and effort expectancy play significant direct roles in continuance intention, with facilitating conditions and trust having indirect influence on continuance intention via post-usage attitude. This suggests that, on the one hand, the two-stage IS continuance model provides a rather stable prediction for how disconfirmation of pre-usage beliefs will influence post-usage beliefs and satisfaction – i.e. pre-usage beliefs will negatively influence disconfirmation of these beliefs, and positive disconfirmation of these beliefs will positively influence the corresponding post-usage beliefs and satisfaction. On the other hand, the influence of post-usage beliefs on continuance intention, which may be either fully or partially mediated via post-usage attitude, may vary across contexts and are beyond the prediction of the ECT framework. This inconsistency is similar to the case of prior technology adoption research in which the influence of salient beliefs on intention may be fully or partially mediated via attitude (Venkatesh *et al*., 2003). Consequently, while expanding the belief set in the two-stage IS continuance model will provide more insights into post-adoption by explaining substantial variance in satisfaction, post-usage attitude and continuance intention, the subtle differences among beliefs pose additional challenges in incorporating the contextual elements into theorising, particularly to explain why different beliefs will directly or indirectly influence users' continuance intention in different contexts.

Practical implications

The results contribute to practice in important ways. This research highlights several factors that can play a role in influencing continuance intention. For example, trust is a predictor of intervening variables that influence continuance intention in e-government technology usage contexts. It suggests that governments should implement better security and privacy protection to foster acceptance and continued usage of e-government technologies. In fact, governments have become more aware of the importance of security. The collective findings from several studies (e.g. West, 2002) show the increasing use of online registration and password for using government Web sites that are expected to implement more advanced security measures built on digital rights management and public key infrastructure in the near future (Kim *et al*., 2006).

The different effects of disconfirmation of effort expectancy and facilitating conditions on user satisfaction suggest governments should take the usage context, i.e. online or offline, into account when determining the essential characteristics (e.g. easy-to-use functionalities or adequate user assistance) of various e-government technologies. In all likelihood, the efforts to implement security go beyond technical issues. As citizens are less likely to comprehend the nuances and subtleties of technical solutions, governments need to develop a proactive approach of educating citizens of what the solutions mean in terms of protecting citizen privacy and confidentiality. Much like Visa and MasterCard evolved towards protecting customers by limiting their liability to $50 of unauthorised use, given our findings, law-makers should consider approaches to truly protect citizens through policies and laws. Perhaps an associated research issue is to understand the economic implications of such policies – i.e. costs to the government (e.g. payout to citizens, legal fees) vs. savings to the government (e.g. increased use of e-government).

This research demonstrates that citizens generally expect a great deal from e-government technologies, as manifested by the high mean scores of beliefs in pre-usage stages (Table 2). While this encourages acceptance, it is equally important to mitigate the discrepancy in pre-usage and post-usage beliefs. Negative disconfirmation will lead to dissatisfaction or even frustration, which inevitably has adverse effects on IS continuance intention and the image of governments. Prior research has suggested that the adoption of a technological innovation creates uncertainty in the minds of potential adopters about its likely consequences (Brown & Venkatesh, 2005). Hands-on experience gained through trial use and training may help reduce the uncertainty and create favourable user perceptions (Venkatesh, 1999). Such experience is necessary, even for professionals with advanced technical knowledge (Rai & Patnayakuni, 1996). Also, active user participation is important to the success of systems development (Ravichandran & Rai, 2000). To minimise the discrepancy in beliefs, governments can consider offering trial use of technologies to get citizens involved in the development process and provide them with hands-on experience that enhance their knowledge of evaluating probable consequences of adopting the technologies. At the same time, trial use of technologies provides an opportunity for governments to gather feedback from citizens in the early stage of development. This would help governments detect problems in e-government projects (e.g. mismatch between the tasks the system supports and those the users want to perform) and take corrective actions before project conditions worsen so as to avoid project escalation, a problem common to e-government and IS projects (e.g. Keil, 1995; Keil & Mann, 2000; Keil *et al*., 2003; Nelson, 2005).

Limitations and future research

This study has some limitations that need to be considered when interpreting the results. First, our findings are subject to single-study bias. In particular, as a group, our study participants were relatively young and savvy in using internet technologies and hail from Hong Kong, which is consistently ranked as a leading nation in technological sophistication. Thus, one future research direction is to replicate this study in other populations – i.e. other countries. However,

this concern is somewhat alleviated given that our findings can serve as a gauge for how the phenomenon may unfold in less technologically sophisticated countries. In any event, given that we have highlighted the importance of context, only future research conducted in different contexts, including different technologies and user groups, can help tease apart the role of general constructs (e.g. perceived usefulness) that play a universal role in driving user behaviours, such as IS continuance intention, vs. contextual constructs (e.g. trust) that play a role only in certain contexts. Second, although we studied UTAUT, we did not include the four moderators – age, gender, experience and voluntariness (Venkatesh *et al*., 2003) – and future research should theorise how these moderators would fit into the ECT framework. Third, consistent with prior research in IS continuance (e.g. Bhattacherjee, 2001; Bhattacherjee & Premkumar, 2004), we used continuance intention as the dependent variable for the current study. While behavioural intention has been well established as a good predictor of behaviour that mediates the effect of other determinants on behaviour (e.g. Venkatesh *et al*., 2003), future research should collect actual usage data to further enhance the criterion validity of the IS continuance model. Fourth, while our work demonstrates the importance of expanding the belief set in order to improve IS continuance, we did not examine any crossover effects of the additional beliefs (e.g. positive disconfirmation in trust improves the perception of usefulness), and future research should theorise how different beliefs may influence each other during the disconfirmation process. Fifth, following the majority of IS research (e.g. McKnight *et al*., 2002; Pavlou & Fygenson, 2006), we conceptualised trust as a combination of competence, benevolence and integrity. Future research should adopt other existing conceptualisations of trust, such as cognitive and affective trust (e.g. McAllister, 1995), and examine their roles in IS continuance. Likewise, other constructs also have alternative conceptualisations that should be investigated: for instance, social influence can also be studied using a social network lens (see Sykes *et al*., 2009). Sixth, as e-government services evolve from being voluntary to mandatory (i.e. the only way to conduct certain transactions is to use e-government services), alternate dependent variables, such as satisfaction, will be important (see Brown *et al*., 2002). Finally, given the growing interest in the nexus of human computer interaction (HCI) and IS research, future research should design and test interventions and its impact on IS continuance use using the model presented here.

CONCLUSIONS

The objectives of this study were to extend and contextualise Bhattacherjee and Premkumar's (2004) two-stage model of IS continuance. We extended their model by incorporating UTAUT's key beliefs of effort expectancy, social influence and facilitating conditions, and integrated the notion of context by including trust because of its relevance for the context of transmission of personal and sensitive information in the online environment. We tested our model using a longitudinal data collection from about 3000 users of two types of e-government technologies. The results demonstrated the roles of various beliefs in predicting pre-usage and post-usage

attitudes and satisfaction in the e-government context, thus providing support for expanding the set of beliefs in the ECT. Overall, the findings of this work enrich our understanding of the phenomenon of postadoption.

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APPENDIX

Measurement items

Perceived usefulness (t_1/t_2)

PU1. Using ***SmartID*** (would enable/enables) me to access government services more quickly.
PU2. Using ***SmartID*** (would make/makes) it easier to access government services.
PU3. Using ***SmartID*** (would enhance/enhances) my effectiveness in accessing government services.

Effort expectancy (t_1/t_2)

EE1. I (would find/find) it easy to use ***SmartID*** to access government services.
EE2. Learning to use ***SmartID*** to access government services (would be/is) easy for me.
EE3. It (would be/is) easy for me to become skillful at using ***SmartID*** to access government services.

Social influence (t_1/t_2)

SI1. People who influence my behavior (would think/think) that I should use ***SmartID*** to access government services.
SI2. People who are important to me (would think/think) that I should use ***SmartID*** to access government services.
SI3. People who are in my social circle (would think/think) that I should use ***SmartID*** to access government services.

Facilitating conditions (t_1/t_2)

FC1. I (would have/have) the resources necessary to use ***SmartID*** to access government services.
FC2. I (would have/have) the knowledge necessary to use ***SmartID*** to access government services.
FC3. A specific person (or group) (would be/is) available for assistance with difficulties using ***SmartID*** to access government services.

Trust (t_1/t_2)

T1. ***SmartID*** (would provide/provides) government services in my best interest.
T2. ***SmartID*** (would provide/provides) access to sincere and genuine government services.
T3. ***SmartID*** (would perform/performs) its role of providing government services very well.

Disconfirmation (perceived usefulness; t_2)

Compared to my initial expectations, the ability of ***SmartID*** _____
DPU1. To enable me to access government services more quickly was (much worse than expected . . . much better than expected).
DPU2. To make it easier to access government services was (much worse than expected . . . much better than expected).
DPU3. To enhance my effectiveness in accessing government services was (much worse than expected . . . much better than expected).

Disconfirmation (effort expectancy; t_2)

Compared to my initial expectations, _____
DEE1. Using ***SmartID*** to access government services was (much more difficult than expected . . . much easier than expected).
DEE2. Learning to use ***SmartID*** to access government services was (much more difficult than expected . . . much easier than expected).

DEE3. Becoming skillful at using ***SmartID*** to access government services was (much more difficult than expected . . . much easier than expected).

Disconfirmation (social influence; t_2)

Compared to my initial expectations, _____
DSI1. The degree to which people who influence my behavior think that I should use ***SmartID*** to access government services was (much lower than expected . . . much higher than expected).
DSI2. The degree to which people who are important to me think that I should use ***SmartID*** to access government services was (much lower than expected . . . much higher than expected).
DSI3. The degree to which people who are in my social circle think that I should use ***SmartID*** to access government services was (much lower than expected . . . much higher than expected).

Disconfirmation (facilitating conditions; t_2)

Compared to my initial expectations, _____
DFC1. The resources necessary to use ***SmartID*** for accessing government services were (much less than expected . . . much more than expected).
DFC2. My knowledge of using ***SmartID*** to access government services was (much less than expected . . . much more than expected).
DFC3. Availability of assistance (from a specific person or a group) with difficulties using ***SmartID*** to access government services was (much worse than expected . . . much better than expected).

Disconfirmation (trust; t_2)

Compared to my initial expectations, _____
DT1. The degree to which ***SmartID*** provides government services in my best interest was (much lower than expected . . . much higher than expected).
DT2. Government services provided by ***SmartID*** were (much less sincere and genuine than expected . . . much more sincere and genuine than expected).
DT3. The ability of ***SmartID*** to perform its role of providing government services was (much worse than expected . . . much better than expected).

Attitude (t_1/t_2)

All things considered, using ***SmartID*** to access government services (would be/is) a
ATT1. bad . . . good idea
ATT2. foolish move . . . wise move
ATT3. negative step . . . positive step

Satisfaction (t_2)

I am _____ with my use of ***SmartID***.
SAT1. Extremely displeased . . . Extremely pleased.
SAT2. Extremely frustrated . . . Extremely contented.
SAT3. Extremely dissatisfied . . . Extremely satisfied.

Continuance intention (t_2)

INT1. I intend to continue using ***SmartID*** to access government services.
INT2. I plan to continue using ***SmartID*** to access government services.
INT3. I will continue using ***SmartID*** to access government services.