

UNDERSTANDING INFORMATION SYSTEMS CONTINUANCE: AN EXPECTATION- CONFIRMATION MODEL¹

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users' confirmation level. This study draws attention to the substantive differences between acceptance and continuance behaviors, theorizes and validates one of the earliest theoretical models of IS continuance, integrates confirmation and user satisfaction constructs within our current understanding of IS use, conceptualizes and creates an initial scale for measuring IS continuance, and offers an initial explanation for the acceptance-discontinuance anomaly.

Abstract

This paper examines cognitive beliefs and affect influencing one's intention to continue using (continuance) information systems (IS). Expectation-confirmation theory is adapted from the consumer behavior literature and integrated with theoretical and empirical findings from prior IS usage research to theorize a model of IS continuance. Five research hypotheses derived from this model are empirically validated using a field survey of online banking users. The results suggest that users' continuance intention is determined by their satisfaction with IS use and perceived usefulness of continued IS use. User satisfaction, in turn, is influenced by their confirmation of expectation from prior IS use and perceived usefulness. Post-acceptance perceived usefulness is influenced by

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Motivation for the Study

The last decade has seen an increasing body of theory-based research on information systems (IS) use. Based on innovation diffusion theory (Rogers 1995), the technology acceptance model (Davis et al. 1989), and the theory of planned behavior (Ajzen 1991), these studies have examined variables that motivate individuals to accept a new IS, and how they do it. While initial acceptance of IS is an important first step toward realizing IS success, long-term viability of an IS

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and its eventual success depend on its *continued* use rather than *first-time* use. This is so because, given its critical role in today's business processes, infrequent, inappropriate, and ineffective long-term use of IS often contributes to corporate failures (Lyytinen and Hirschheim 1987). Understanding continued use or "continuance" (in contrast to initial use or "acceptance") is the goal of this study.

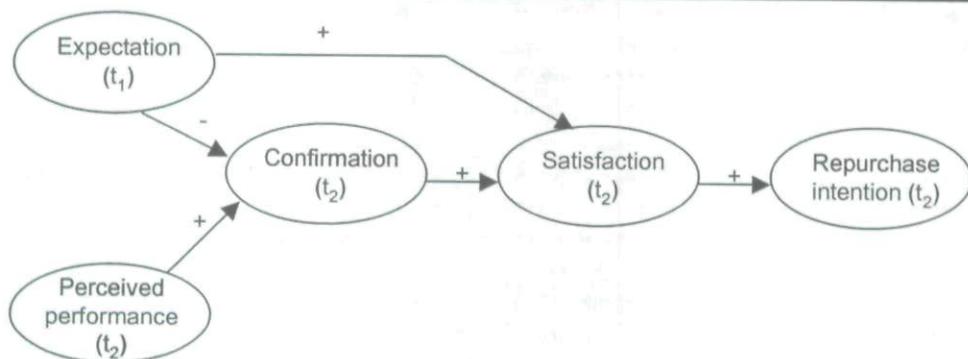
IS continuance at the individual user level is also central to the survival of many business-to-consumer electronic commerce firms, such as Internet service providers (ISPs), online retailers, online banks, online brokerages, online travel agencies, and the like. The effective subscriber base, market share, and revenues of these firms depend on *both* the number of initial adopters (new subscriptions) and the number of continued users (subscription renewals). The importance of continuance, vis-à-vis acceptance, is evident from the fact that acquiring new customers may cost as much as five times more than retaining existing ones, given the costs of searching for new customers, setting up new accounts, and initiating new customers to the IS (Parthasarathy and Bhattacherjee 1998). For example, a 5% increase in customer retention in the insurance industry typically translates into 18% savings in operating costs (Crego and Schiffrin 1995). Such trends underscore the importance, relevance, and timeliness of studying IS continuance as a topic of organizational interest.

Continuance is not entirely an alien concept in IS research. It has been examined variously as "implementation" (Zmud 1982), "incorporation" (Kwon and Zmud 1987), and "routinization" (Cooper and Zmud 1990) in the IS implementation literature. These studies acknowledge the existence of a post-acceptance stage when IS use transcends conscious behavior and becomes part of normal routine activity. Likewise, innovation diffusion theory, in its five-stage adoption decision process (consisting of knowledge, persuasion, decision, implementation, and confirmation phases), suggests that adopters reevaluate their earlier acceptance decision during a final "confirmation" stage and decide whether to continue or discontinue using an innovation (Rogers 1995). However, these studies view continuance as an

extension of acceptance behaviors (i.e., they employ the same set of pre-acceptance variables to explain both acceptance and continuance decisions), implicitly assume that continuance covaries with acceptance (e.g., Davis et al. 1989; Karahanna et al. 1999), and are, therefore, unable to explain why some users discontinue IS use after accepting it initially (the "acceptance-discontinuance anomaly"). Further, prior research does not elaborate upon users' psychological motivations "emerging" *after* their initial acceptance—which potentially influence users' subsequent continuance decisions but not their prior acceptance decisions. In sum, current acceptance models provide a limited explanation of, and may sometimes contradict, observed continuance behaviors.

This paper is one of the earliest to conceptualize and test a theoretical model of IS continuance that takes into account the above distinctions between acceptance and continuance behaviors. The proposed model is based on expectation-confirmation theory (ECT) (Oliver 1980), which is further refined using auxiliary theories and empirical findings from prior IS use research. The hypothesized model is then validated empirically using data from a field survey of online banking users. Research questions addressed in this paper are: (1) what are the salient motivations underlying IS users' intention to continue using an IS after its initial acceptance, and (2) how do these motivations influence continuance intention? This study is similar in spirit to Davis et al.'s formulation of the technology acceptance model (TAM) in that it adapts ECT from the consumer behavior literature to propose a model of IS continuance, just as TAM adapted the theory of reasoned action from the social psychology literature to postulate a model of IS acceptance.

The remainder of the paper proceeds as follows. The next section describes ECT and integrates it with prior IS usage research to theorize a model of IS continuance behavior. The third section describes the research methodology used to empirically test the research model. The fourth section presents the results of data analysis. The fifth section discusses research implications for the study's key findings and its limitations. The final section summarizes the study's core findings and its contributions.



Note: t₁ = pre-consumption variable; t₂ = post-consumption variable

Figure 1. Expectation-Confirmation Theory

Theoretical Background

Expectation-Confirmation Theory

Expectation-confirmation theory (ECT) is widely used in the consumer behavior literature to study consumer satisfaction, post-purchase behavior (e.g., repurchase, complaining), and service marketing in general (Anderson and Sullivan 1993; Dabholkar et al. 2000; Oliver 1980, 1993; Patterson et al. 1997; Tse and Wilton 1988). The predictive ability of this theory has been demonstrated over a wide range of product repurchase and service continuance contexts, including automobile repurchase (Oliver 1993), camcorder repurchase (Spreng et al. 1996), institutional repurchase of photographic products (Dabholkar et al. 2000), restaurant service (Swan and Trawick 1981), and business professional services (Patterson et al. 1997). Figure 1 illustrates key constructs and relationships in ECT.

The process by which consumers reach repurchase intentions in an ECT framework is as follows (Oliver 1980). First, consumers form an initial *expectation* of a specific product or service prior to purchase. Second, they accept and use that product or service. Following a period of initial consumption, they form perceptions about its *performance*. Third, they assess its perceived performance vis-à-vis their original expectation

and determine the extent to which their expectation is confirmed (*confirmation*²). Fourth, they form a *satisfaction*, or affect, based on their confirmation level and expectation on which that confirmation was based. Finally, satisfied consumers form a *repurchase intention*, while dissatisfied users discontinue its subsequent use.

ECT holds that consumers' intention to repurchase a product or continue service use is determined primarily by their satisfaction with prior use of that product or service (Anderson and Sullivan 1993; Oliver 1980, 1993). Satisfaction is viewed as the key to building and retaining a loyal base of long-term consumers: "Investing in customer satisfaction is like taking out an insurance policy. If some temporary hardship befalls the firm, customers will be more likely to remain loyal" (Anderson and Sullivan 1993, p. 160).

Satisfaction was initially defined by Locke (1976, p. 1300) in the context of job performance as "a pleasurable or positive emotional state resulting from the appraisal of one's job." This definition was extended by Oliver (1981, p. 29) to the consumption context as "the summary psychologi-

²This construct is also labeled "disconfirmation" in the marketing literature, and ECT is also called "disconfirmation of expectations" theory.

cal state resulting when the emotion surrounding disconfirmed expectations is coupled with the consumer's prior feelings about the consumption experience." Both definitions underscore a psychological or affective state related to and resulting from a cognitive appraisal of the expectation-performance discrepancy (confirmation). Lower expectation and/or higher performance lead to greater confirmation, which in turn positively influence customer satisfaction and continuance intention. The reverse causes disconfirmation, dissatisfaction, and discontinuance intention. Hence, as shown in Figure 1, confirmation is inversely related to expectation and directly related to perceived performance.

ECT also theorizes expectation as an additional determinant of satisfaction, because expectation provides the baseline or reference level for consumers to form evaluative judgments about the focal product or service. Support for this association comes from Helson's (1964) adaptation level theory, which posits that human beings perceive stimuli relative to or as a deviation from an "adapted level" or baseline stimulus level. This adapted level is determined by the nature of the stimulus, psychological characteristics of the individual experiencing that stimulus, and situational context. A high baseline level or expectation tends to enhance one's satisfaction, while low expectation reduces consequent satisfaction.

However, ECT has been the subject of several debates. First, ECT ignores potential changes in consumers' expectation following their consumption experience and the impact of these changes on subsequent cognitive processes. Consumers' expectation is often "colored" by their first-hand experience. Thus, their post-purchase expectation may be different from their pre-purchase expectation. Pre-acceptance expectation is typically based on others' opinions or information disseminated through mass media, while post-acceptance expectation is tempered by the consumers' first-hand experience and is, therefore, more realistic (Fazio and Zanna 1981). For instance, post-purchase expectation may be enhanced if consumers "discover" new product or service benefits beyond their initial expectation—or lowered if the product or service is found

to be less useful. These changes are explained by self-perception theory (Bem 1972), which posits that individuals continually adjust their perceptions (e.g., expectation) as they acquire new information about the focal behavior (by observing others' and their own behaviors). The adjusted perceptions then provide the basis for subsequent behaviors. Hence, once updated, post-consumption (modified) expectation replaces pre-consumption (initial) expectation in consumers' cognitive memory as the basis for guiding subsequent decision processes. As elaborated upon later, this study postulates satisfaction as an additive function of *modified* (rather than *initial*) expectation and confirmation.

Second, initial studies of ECT present varying and conflicting conceptualizations of the satisfaction construct (Yi 1990). For instance, some authors view satisfaction as synonymous with attitude and emotion, because all three constructs connote affect (e.g., LaTour and Peat 1979). However, satisfaction is conceptually distinct from attitude in that satisfaction is a transient, experience-specific affect, while attitude is a relatively more enduring affect transcending all prior experiences (Oliver 1980, 1981). Tse and Wilton (1988) demonstrate that satisfaction and attitude differ in their predictive abilities, while Oliver (1980) observes that satisfaction temporally and causally precedes post-purchase attitude in a path-analytic model. Hunt (1977) argues that attitude is an emotion (e.g., pleasure), but satisfaction is an evaluation of that emotion (i.e., whether a consumption experience was as pleasurable as expected). Hence, one may have a pleasant experience with a product or service (i.e., positive attitude), but still feel dissatisfied if it is below expectation.

Third, conceptualization of expectation also differs across ECT studies. Some studies define expectation in terms of pre-consumption beliefs about the overall performance of products or services and operationalize it as "anticipated performance" (e.g., Westbrook and Reilly 1983). Others define it as beliefs about the level of product or service attributes and operationalize it as either individual beliefs (i.e., B_i) or the summation of such beliefs (i.e., ΣB_i) (e.g., Oliver and Linda 1981). Oliver (1980; 1981) defines expectation as beliefs

weighed with an evaluation of outcomes (e_i) in an expectancy theoretic sense (i.e., $\Sigma B_i e_i$), similar to that in many attitude theories (e.g., Ajzen and Fishbein 1977). However, the high correlation observed between belief (ΣB_i) and belief-evaluation ($\Sigma B_i e_i$) operationalizations (Swan and Trawick 1981) suggests that the belief representation is not substantially different from (though conceptually simpler than) the belief-evaluation representation. The next section examines how ECT can serve as a useful theoretical framework for explaining IS continuance behaviors.

An Expectation-Confirmation Model of IS Continuance

IS users' continuance decision is similar to consumers' repurchase decision because both decisions (1) follow an initial (acceptance or purchase) decision, (2) are influenced by the initial use (of IS or product) experience, and (3) can potentially lead to ex post reversal of the initial decision. IS continuance often imposes monetary and non-monetary costs on IS users. Hence, rational users most likely go through a non-trivial decision process, similar to that in ECT, prior to making an informed decision choice. However, in order to adapt ECT to a different context (i.e., IS continuance), several theoretical extensions are required. Such extensions provide unique opportunities for theory refinement. Potentially they can explain IS continuance decisions better than ECT alone.

First, while ECT examines both pre-consumption and post-consumption variables (indicated by t_1 and t_2 respectively in Figure 1), the proposed continuance model focuses only on post-acceptance variables. This is so because the effects of any pre-acceptance variables are already captured within the confirmation and satisfaction constructs. Second, ECT only examines the effect of pre-consumption (ex ante) expectation, but not post-consumption (ex post) expectation. As described before, ex post expectation is especially important for products or services where expectation may change with time, as is often the case with IS use. Hence, the proposed continuance model amends ECT to include ex post expec-

tation. Third, (ex post) expectation is represented in the proposed model by (ex post) perceived usefulness. This representation is consistent with ECT's definition of expectation as individual beliefs (B_i) or sum of beliefs (ΣB_i), because perceived usefulness is a cognitive belief salient to IS use (Davis et al. 1989). Although expectation theoretically may be a broader construct, encompassing many additional beliefs (e.g., ease of use), based on TAM-based studies, perceived usefulness is an adequate expectation in the IS continuance context because it is the only belief that is demonstrated to consistently influence user intention across temporal stages of IS use (e.g., Davis et al. 1989; Karahanna et al. 1999). Figure 2 shows proposed associations among these constructs.

Per ECT, users' IS continuance intention is determined primarily by their satisfaction with prior IS use. Several industry studies provide anecdotal evidence for this association. For instance, an Inteco (1998) study cites negative experiences and dissatisfaction resulting from slow access or engaged lines, poor help lines, and other technical problems as ISP users' primary reasons for service termination. Recall that satisfaction is an affect, captured as a positive (satisfied), indifferent, or negative (dissatisfied) feeling. Affect (as attitude) has been theorized and validated in TAM-based studies as an important predictor of intention concerning IS use (e.g., Davis et al. 1989; Karahanna et al. 1999; Taylor and Todd 1995). These studies provide indirect support for the satisfaction-continuance intention association derived from ECT. This leads to the first hypothesis:

H1. Users' level of satisfaction with initial IS use is positively associated with their IS continuance intention.

ECT posits that user satisfaction is determined by two constructs: expectation of the IS and confirmation of expectation following actual use. Expectation provides the baseline level, against which confirmation is assessed by users to determine their evaluative response or satisfaction. Confirmation is positively related to satisfaction with IS use because it implies realization of the

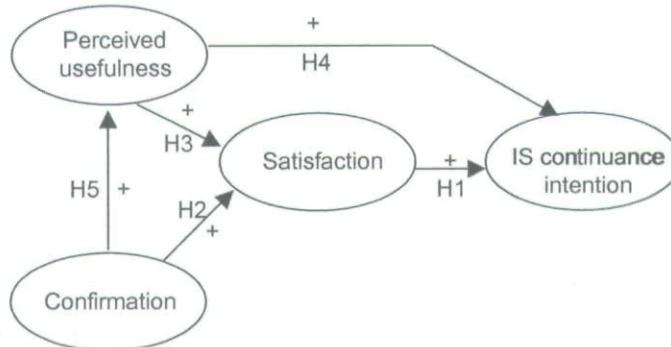


Figure 2. A Post-Acceptance Model of IS Continuance

expected benefits of IS use, while disconfirmation (perceived performance lagging expectation) denotes failure to achieve expectation. Although the confirmation-satisfaction association is yet to be examined empirically in IS use research, industry studies provide anecdotal support for this association. For instance, online brokerage users attribute their service dissatisfaction to brokers' inability to maintain server uptime, execute timely orders, and provide reasonable margin rates (Selwyn 1999). Similarly, online shoppers are disillusioned and dissatisfied with late deliveries, inaccurate billing, and non-availability of items listed on e-retailing sites (Sliwa and Collett 2000). Hence:

H2. Users' extent of confirmation is positively associated with their satisfaction with IS use.

As described before, drawing from TAM (e.g., Davis et al. 1989), post-consumption expectation is represented as ex post perceived usefulness in the proposed IS continuance model. TAM found perceived usefulness and perceived ease of use as salient beliefs influencing IS acceptance behaviors across a broad range of end-user computing technologies and user populations (e.g., Davis et al. 1989; Mathieson 1991; Taylor and Todd 1995). Perceived usefulness captures the instrumentality of IS use, while ease of use taps into the self-efficacy dimension. Because perceived usefulness and ease of use are the primary motivators of IS acceptance, it is plausible that

they can also influence subsequent continuance decisions. However, empirical studies comparing the relative effects of perceived usefulness and ease of use during pre-acceptance and post-acceptance stages of IS use report that (1) usefulness impacts attitude substantively and consistently during both stages of IS use, and (2) ease of use has an inconsistent effect on attitude in the initial stages, which seems to further subside and become non-significant in later stages (Davis et al. 1989; Karahanna et al. 1999). This finding led Karahanna et al. to observe,

users gain experience with the system, ease of use concerns seem to be resolved and displaced by more instrumental considerations involving the efficiency of the innovation to increase one's job performance (i.e., perceived usefulness). (p. 200)

In keeping with these observations, perceived usefulness is expected to be the most salient ex post expectation influencing users' post-acceptance affect (satisfaction).³ Hence:

H3. Users' perceived usefulness of IS use is positively associated with their satisfaction with IS use.

³An informal test validated the expected non-significant effect of perceived ease of use on satisfaction in this study, although this association was not stated or tested as a formal hypothesis.

TAM hypothesizes perceived usefulness as a direct predictor of acceptance intention (in addition to its indirect effect via attitude) to account for circumstances where high instrumentality considerations may override low affect in motivating usage intentions. As Davis et al. note,

people form intentions toward behaviors they believe will increase their job performance, over and above whatever positive or negative feelings may be evoked toward the behavior. (p. 986)

Enhanced performance is instrumental in achieving various rewards that are extrinsic to the task context, such as promotions or monetary gains (Vroom 1964). IS use is often viewed as the means to that end. Such means-end behavior is largely based on cognitive decision rules or heuristics that are invoked without conscious thought whenever faced with similar behavioral contexts, without necessarily activating the positive affect associated with performance-contingent rewards (Davis et al. 1989). Although the usefulness-intention association was originally derived in an acceptance context, it is likely to hold true in continuance contexts, because human tendencies for subconsciously pursuing instrumental behaviors or striving for rewards are independent of the timing or stage of such behaviors. This leads to the fourth hypothesis:

H4. Users' IS continuance intention is positively associated with their perceived usefulness of IS use.

Finally, just as the cognitive beliefs in IS acceptance contexts (i.e., ease of use and perceived usefulness) are related (Davis et al. 1989), those in IS continuance contexts (i.e., confirmation and perceived usefulness) may also be related. For instance, users may have low initial usefulness perceptions of a new IS because they are unsure what to expect from its use. Nonetheless, they may still want to accept it with the intent of making their usage experience a basis for forming more concrete perceptions. Although low initial usefulness perceptions are easily confirmed, such perceptions may be adjusted higher as a result of the confirmation experience, when users realize that their initial perceptions were unrealistically

low. Theoretical support for this association comes from cognitive dissonance theory (Festinger 1957), which suggests that users may experience cognitive dissonance or psychological tension if their pre-acceptance usefulness perceptions (which earlier led to acceptance) are disconfirmed during actual use. Rational users may try to remedy this dissonance by distorting or modifying their usefulness perceptions in order to be more consistent with reality. In other words, confirmation will tend to elevate users' perceived usefulness and disconfirmation will reduce such perceptions. Hence:

H5. Users' extent of confirmation is positively associated with their perceived usefulness of IS use.

In order to highlight the value-added by the proposed IS continuance model, it is instructive to compare it with TAM as an IS acceptance model. The continuance model is similar to TAM on two counts: (1) it employs individual cognitive factors for predicting (continued) IS use, and (2) it reflects the belief-affect-intention causality characteristic of most IS use theories. However, the proposed model is different from TAM on at least three counts. First, it explains continuance behaviors, in contrast to TAM, which focuses on initial acceptance (but has been applied to both acceptance and continuance contexts). As stated before, acceptance and continuance are two temporally and conceptually distinct and possibly incongruent phases of IS use. Second, although no study has yet compared TAM with ECT in continuance contexts, ECT is a theoretically richer model by virtue of its inclusion of unique post-acceptance variables (satisfaction, confirmation). Because these variables are in greater temporal proximity to post-acceptance (continuance) behavior, they are likely to predict continuance better than TAM's pre-acceptance variables (i.e., usefulness, ease of use, and attitude). Third, TAM cannot provide a reasonable explanation of acceptance-discontinuance anomaly based on a common set of pre-acceptance variables. ECT explains this anomaly by suggesting that one's disconfirmation and dissatisfaction with IS use may lead to its eventual discontinuance, despite positive perceptions of pre-acceptance variables. Empirical testing of the proposed model follows in the next section.

Research Methodology

Data Collection

Empirical data for this study was collected via a cross-sectional field survey of online banking users. An online banking context was selected because banking is an information-intensive activity. Moreover, historically the banking industry has been aggressive in deploying IS (Tan and Teo 2000). Survey respondents were customers of the online banking division (OBD) of one of the largest national banks in the United States. OBD offers its customers an integrated suite of online personal banking products including online checking and savings accounts, money market accounts, certificates of deposit, credit cards, home equity loans, home mortgage, insurance, investment services, portfolio management, and retirement planning services. Compared to traditional "brick-and-mortar" customers, OBD customers enjoy higher yields on their accounts, greater flexibility and convenience (e.g., 24-hour integrated online access to all accounts), and sophisticated financial management tools (e.g., online bill payment, online funds transfer, online transaction register, custom reporting tools). The choice of a single data collection site controlled for the potential effects of macro-level firm variables (e.g., customer interface, infrastructural constraints) on individual use behavior, thereby increasing the likelihood of detecting the desired micro-level individual effects.

The sample consisted of 1,000 online customers randomly selected by OBD from its customer base of over 1 million users. Each customer received an electronic mail message from OBD soliciting their participation in a survey of online banking practices, appended to their regular monthly statements (also distributed via e-mail). The message outlined the purpose of the study, provided a hyperlink to an online survey form, and, as an incentive, offered respondents the opportunity to register in a drawing of small cash prizes. Customer responses were edited by OBD to remove any identifying data (e.g., e-mail addresses, IP addresses, and user names) before making them available to the researcher.

Online field surveys have several advantages over traditional paper-based mail surveys: (1) lower costs, (2) faster responses, and (3) geographically unrestricted sample (Tan and Teo 2000). Such surveys are routinely employed by consulting firms to collect industry data, by business firms to solicit employee opinions on corporate issues, and by news organizations to conduct online public polls. They are beginning to gain acceptance in IS research (e.g., Tan and Teo 2000). Although novel in IS research, an online survey was appropriate for this study because customers' online (banking) behavior was the object of investigation. All respondents indicated that they were comfortable with the process of filling out online surveys. Hence the online data collection method was not expected to introduce any novelty bias in the responses.

Following a single round of data collection, 122 usable responses were obtained for a response rate of about 12%. The low response rate may be attributed to the fact that the solicitation message was attached to the end of customers' monthly statements. Therefore, it may have been missed by some customers. Further, OBD was unwilling to send follow-up requests to non-respondents at the risk of being perceived by customers as a "spammer." Hence, multiple rounds of data collection were not possible.

The respondent group ranged in age from 17 to 63 (mean of 33.7 years), were 62% male, had annual incomes between \$10,000 and \$250,000 (mean of \$75,000), subscribed to a wide range of professions (students, professionals, self-employed, academics, executives, retirees), and had diverse educational levels (from high-school graduates to doctoral degrees). The respondents had online accounts for two months to three years (mean of eight months), online balances between \$100 and \$50,000 (mean of \$7,000), with 92% also maintaining traditional bank accounts (in addition to their online accounts). At the time of the survey, 18% of the respondents had changed their online banks at least once, citing dissatisfaction with banking experience, poor customer service, and slow server responses as the primary reasons for discontinuing with their previous online banks.

Table 1. Operationalization of Constructs

Construct	Operational Definition	How Measured
IS continuance intention	Users' intention to continue using OBD.	Extended from Mathieson's (1991) behavioral intention scale.
Satisfaction	Users' affect with (feelings about) prior OBD use.	Adapted from Spreng et al.'s (1996) overall satisfaction scale.
Perceived usefulness	Users' perception of the expected benefits of OBD use.	Adapted from Davis et al.'s (1989) perceived usefulness scale.
Confirmation	Users' perception of the congruence between expectation of OBD use and its actual performance.	New scale developed.

Instrument Construction

Four constructs were measured in this study: IS continuance intention, satisfaction, perceived usefulness, and confirmation. Constructs were measured using multiple-item scales, drawn from prevalidated measures in IS use or ECT research (wherever possible), and reworded to relate specifically to the context of OBD use. Satisfaction items were based on seven-point semantic differential scales. All remaining scale items used seven-point Likert scales anchored between "strongly disagree" and "strongly agree." Table 1 provides operational definitions and sources for these constructs. The Appendix lists the scale items.

IS continuance intention was measured using two items adapted from Mathieson's (1991) behavioral intention (to accept IS) scale. A third item was added to meet Nunnally's (1978) suggested norm of at least three items per construct. The two initial items measured respondents' intention to continue OBD use as opposed to discontinuing its use or using any alternate services such as traditional banking. The third item assessed respondents' overall discontinuance intention (worded negatively to control for potential common-method bias). Perceived usefulness items were adapted from Davis et al.'s (1989) four-item perceived usefulness scale. Originally

intended for the IS acceptance context, the first three items of this scale tap into the performance, productivity, and effectiveness dimensions of OBD usefulness, while the fourth item assesses overall usefulness.

Satisfaction was measured using Spreng et al.'s (1996) overall satisfaction scale from the ECT literature, originally designed to assess users' satisfaction with camcorder use. This scale captured respondents' satisfaction levels along seven-point scales anchored between four semantic differential adjective pairs: "very dissatisfied/very satisfied," "very displeased/very pleased," "very frustrated/very contented," and "absolutely terrible/absolutely delighted." This scale was appropriate because affect such as satisfaction is best measured along bipolar evaluative dimensions (e.g., good/bad) (Ajzen and Fishbein 1977). Further, this semantic differential technique distinguished the satisfaction scale clearly from other constructs that used Likert scales. Prior satisfaction instruments from the IS literature, such as Doll and Torkzadeh's (1988) end-user computing satisfaction scale or Ives et al.'s (1983) user information satisfaction scale, were not employed because (1) these scales conceptualized satisfaction as a collection of beliefs about the information provided by an IS (e.g., accuracy, format, timeliness, reliability), rather than as affect toward the system itself, and

(2) they were too long to incorporate in studies where multiple constructs are being measured (e.g., Ives et al.'s short-form instrument contains 39 items). This satisfaction scale is similar to attitude scales used in IS acceptance research (and reasonably so because both constructs connote affect). Nonetheless, this scale captured post-usage affect in contrast to pre-usage affect captured in attitude scales.

Confirmation is operationalized in the ECT literature in three ways: objective, inferred, and perceived (Yi 1990). Objective confirmation employs an external judge to "objectively" assess the expectation-performance discrepancy under the assumption that product or service performance can be judged uniformly across consumers using some predefined and unambiguous criteria (Olshavsky and Miller 1972). Despite ease of measurement and manipulation, objective confirmation is not an accurate predictor of satisfaction because it ignores variations in consumers' expectation and performance perceptions (Yi 1990). Inferred confirmation calculates the expectation-performance discrepancy in terms of prespecified product or service attributes. It is assessed as a summation of difference scores rated by consumers on pre-selected attributes before and after the consumption experience (Swan and Trawick 1981). Perceived confirmation represents consumers' subjective post-only rating of the same discrepancy, either at overall product or service level or at individual attribute level (Oliver 1980; Tse and Wilton 1988).

Although inferred and perceived confirmation are both good predictors of satisfaction, inferred confirmation suffers from several limitations (Yi 1990). First, post-consumption ratings may be biased by pre-consumption ratings (consistency bias) because respondents may provide similar ratings in order to be internally consistent, potentially ignoring their true post-consumption beliefs. Second, inferred confirmation suffers from a "ceiling or floor effect." If respondents give the highest (lowest) rating on the pre-consumption scale and the product performs well above (below) expectations, they can still only give the highest (lowest) rating on the post-consumption scale, inappropriately implying a confirmation of magnitude zero. Third, the reliability of a difference

score decreases with decreasing variance in either the pre- or post-consumption ratings, which is likely in inferred confirmation because the two ratings tend to be highly correlated (Prakash 1984). Fourth, a model that includes expectation, perceived performance, and inferred confirmation is likely to be over-specified because inferred confirmation is determined entirely by the first two variables. Finally, perceived confirmation is empirically found to predict satisfaction better than inferred confirmation, even with a single-item measure ($R^2 = 0.73$ versus 0.56) (Tse and Wilton 1988), because of its temporal proximity to satisfaction and because human intentions are guided by perceptions (of confirmation), even if such perceptions are biased or inaccurate (Ajzen and Fishbein 1977). Given these limitations, Yi recommends perceived confirmation as the most appropriate measure of confirmation. Further, attribute-level measurement of perceived confirmation does not provide any significant improvement in explanation over overall product-level measurement (Oliver 1980). Hence, product-level confirmation is adequate for most studies.

Prior perceived confirmation scales in the ECT literature have employed items such as "unsatisfactory," "extremely pleasing" (which reflect satisfaction), or "would come here again" (which overlap with intention) (e.g., Oliver and Linda 1981; Swan and Trawick 1981). Given the potential confounding of these items with other constructs of interest (e.g., satisfaction, intention), three confirmation items were indigenously created based on the conceptual definition of this construct (i.e., respondents' perception of the expectation-performance congruence). Two of these items examined the perceived congruence in terms of user experience and service level. The third item assessed respondents' overall extent of confirmation.

Data Analysis and Results

Scale Validation

Construct validity for the four measurement scales (IS continuance intention, satisfaction, perceived usefulness, and confirmation) was assessed via

confirmatory factor analysis (CFA) using the EQS program (Bentler 1989). Each scale item was modeled as a reflective indicator of its hypothesized latent construct. The four constructs were allowed to covary in the CFA model. Model estimation was done using the maximum likelihood approach, with the item correlation matrix used as input. Tables 2 and 3 present the results of the CFA analysis. The Appendix shows the loadings from a separate exploratory factor analysis (EFA). As an initial check of data quality, standardized residuals among individual scale items ranged between -0.096 and 0.104, well below the recommended threshold value of 3.0.

The first step in scale validation was to examine the goodness-of-fit of the overall CFA model. For models with good fit, it is suggested that chi-square normalized by degrees of freedom (χ^2/df) should not exceed 5 (Bentler 1989), and Bentler-Bonett Non-Normed Fit Index (NFI) and Comparative Fit Index (CFI) should both exceed 0.9.⁴ For the current CFA model, χ^2/df was 1.63 ($\chi^2 = 116.21$; $\text{df} = 71$), NFI was 0.94, and CFI was 0.95 (see Table 2), suggesting adequate model fit.

Second, convergent validity was evaluated for the four measurement scales using three criteria suggested by Fornell and Larcker (1981): (1) all indicator factor loadings (λ) should be significant and exceed 0.7, (2) construct reliabilities should exceed 0.80, and (3) average variance extracted (AVE) by each construct should exceed the variance due to measurement error for that construct (i.e., AVE should exceed 0.50). All λ -values in the CFA model exceeded 0.7 and were significant at $p = .001$ (see t-values in Table 2). Composite reliabilities (ρ_c) of constructs ranged between 0.82 and 0.88 (see Table 3). AVE ranged from 0.60 to 0.65 (see Table 3), greater than variance due to measurement error. Hence, all three conditions for convergent validity were met.

Finally, discriminant validity was assessed using a series of chi-square difference tests (Bagozzi and Phillips 1982), where the χ^2 statistic of the unconstrained CFA model (with all constructs freely correlated) is compared with that of a constrained model (with covariance between two constructs set equal to 1). A significant χ^2 difference between the two models indicates discriminant validity between the constrained pair of constructs. As shown in Table 4, such χ^2 differences in this study ranged between 51.77 and 163.49 ($p < .001$), demonstrating adequate discriminant validity for all scales. Fornell and Larcker (1981) recommend a stronger test of discriminant validity, where the AVE for each construct should exceed the squared correlation between that and any other construct. The factor correlation matrix in Table 3 indicates that the largest squared correlation between any pair of constructs was 0.44 (continuance intention and satisfaction), while the smallest AVE was 0.60. Hence, the latter test of discriminant validity was also met.

Hypotheses Testing

The five hypotheses presented earlier were tested collectively using the structural equation modeling (SEM) approach, also performed using EQS. This approach is particularly appropriate for testing theoretically justified models (Bentler and Bonnett 1980), as was the case in this study. Each indicator was modeled in a reflective manner (as in CFA), the four constructs were linked as hypothesized (see Figure 2), and model estimation was done using the maximum likelihood technique.

The goodness-of-fit of the structural model was comparable to that of the previous CFA model. Model χ^2/df was 1.717 ($\chi^2 = 116.76$; $\text{df} = 68$), NFI was 0.93, and CFI was 0.95 (see Figure 3). These metrics provided evidence of adequate fit between the hypothesized model and the observed data.

Next, the path significance of each hypothesized association in the research model and variance explained (R^2 value) by each path were examined. Figure 3 shows the standardized path coefficients and path significances, as reported by EQS. All

⁴Bentler-Bonett Normed Fit Index (NFI) is sensitive to sample size and may indicate poor fit with small samples even when the model is correct and is, therefore, not a reliable indicator of model fit (Bentler and Bonnett 1980).

Table 2. Measurement Model

Item	Item Mean	Standard Deviation	Standardized Item Loading ^a	Error Loading	t-statistic (for λ)
CI1	5.26	1.23	.760	.650	9.23
CI2	4.96	1.06	.803	.596	9.95
CI3	4.85	0.95	.806	.592	10.01
S1	4.71	0.89	.792	.610	10.01
S2	4.66	0.74	.751	.660	9.28
S3	4.89	0.99	.830	.558	10.72
S4	5.11	1.03	.765	.644	9.53
PU1	5.89	1.28	.863	.504	11.43
PU2	5.42	1.14	.837	.547	10.91
PU3	5.95	1.38	.764	.645	9.55
PU4	5.11	1.11	.764	.646	9.54
C1	5.13	1.21	.752	.660	8.92
C2	4.96	1.05	.787	.618	9.46
C3	5.36	1.51	.790	.614	9.51

Legend: CI = IS continuance intention, S = Satisfaction, PU = Perceived Usefulness, C = Confirmation.

Model fit: $\chi^2 = 116.21$ (df = 71, $p < .001$), NFI = 0.884, NNFI = 0.936, CFI = 0.950.

^aAll item loadings (λ) were significant at $p = .001$ level.

Table 3. Scale Properties and Correlations

Construct	Number of Items	Reliability ^a	AVE ^b	Factor Correlations			
				CI	S	PU	C
CI	3	.83	.62	1.00			
S	4	.87	.61	.66	1.00		
PU	4	.88	.65	.53	.42	1.00	
C	3	.82	.60	.41	.59	.43	1.00

Legend: CI = IS continuance intention, S = Satisfaction, PU = Perceived usefulness, C = Confirmation.

^aReliability computed as: $\rho_c = (\Sigma)^2 / [(\Sigma)^2 + \sum \text{var}(\varepsilon)]$; λ and ε estimates provided in Table 2.

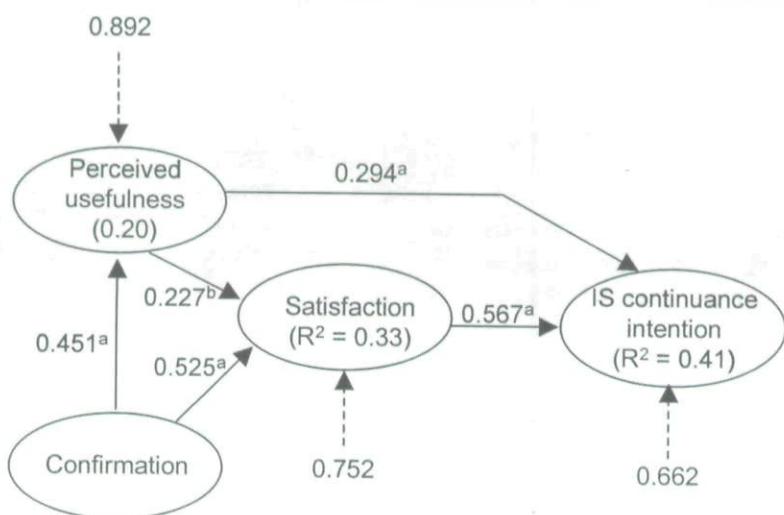
^bAVE is average variance extracted (i.e., proportion of variance in construct that is not due to measurement error)

Table 4. Chi-Square Tests of Discriminant Validity

Variables Constrained	Chi-square	Degrees of Freedom	Chi-square Difference ^a
None	116.21	71	-
CI + S	167.98	72	51.77
CI + PU	204.29	72	88.08
CI + C	210.24	72	94.03
S + PU	279.70	72	163.49
S + C	180.43	72	64.22
PU + C	213.37	72	97.16

Legend: CI = IS continuance intention, S = Satisfaction,
PU = Perceived usefulness, C = Confirmation.

^aAll χ^2 differences were significant at $p = .001$ level.



Note: Measurement model not shown above for purposes of clarity.

Model fit: $\chi^2 = 116.76$ (df = 68, $p < .001$), NFI = 0.883, NNFI = 0.928, CFI = 0.946

Path significance: ^a $p < .001$, ^b $p < .01$

Figure 3. EQS Analysis of Research Model

five hypothesized paths in the model were significant at $p < 0.01$. Intention to continue IS use was predicted by satisfaction ($\beta = 0.57$) and perceived usefulness ($\beta = 0.29$), which explained 32% and 9% of the intention variance respectively. In addition to its direct effect, perceived usefulness also had a small indirect effect on IS continuance intention ($\beta = 0.13$) via the satisfaction construct, explaining 1.7% of the variance in the dependent variable. Satisfaction, in turn, was predicted by confirmation ($\beta = 0.53$) and perceived usefulness ($\beta = 0.23$), which explained 28% and 5% of the satisfaction variance respectively. Confirmation also had a small indirect effect ($\beta = 0.10$) on satisfaction, via the perceived usefulness construct. Finally, confirmation was a significant predictor of perceived usefulness ($\beta = 0.45$), explaining 20% of the usefulness variance. Implications of these effects for IS continuance are discussed in the next section.

respectively). The effect of perceived usefulness on users' intention in both acceptance and continuance contexts attests to the robustness and salience of this association across temporal stages of IS use. However, the size of this effect, relative to that of affect, seems to decrease over time. ECT provides some intuition for understanding this change. Users' pre-acceptance attitude is based solely on cognitive beliefs (e.g., usefulness, ease of use) formed potentially via second-hand information from referent others, popular media, or other sources. These influence sources may be biased. Hence, user attitude potentially may be inaccurate, unrealistic, and uncertain. In contrast, post-acceptance satisfaction is grounded in users' first-hand experience with the IS. It is, therefore, more realistic, unbiased, and less susceptible to change (Fazio and Zanna 1981). Users' may accommodate this uncertainty in affect by underweighting more uncertain attitude in their acceptance decisions and overweighting more certain satisfaction in continuance decisions.

Discussion of Results

Explaining IS Continuance Intention

Results of the study support ECT's contention that satisfaction with IS use is the strongest predictor of users' continuance intention ($R^2 = 0.32$), followed by perceived usefulness as a significant but weaker predictor ($R^2 = 0.09$). Coupled with a strong intention-behavior association theorized and validated in prior IS use research (e.g., Davis et al. 1989; Taylor and Todd 1995), the above associations suggest that satisfaction and perceived usefulness are important (indirect) predictors of actual continuance behaviors.

The above finding has important implications for IS practice. While ignoring pre-acceptance user attitude may not severely impact IS product or service acceptance among new users, ignoring post-acceptance user satisfaction can have disastrous consequences for user retention (continuance). Because perceived usefulness is more crucial for acceptance intention and satisfaction is more dominant for continuance intention, IS firms and other supply-side institutions responsible for enhancing IS use should adopt a two-fold strategy for maximizing their return on investments in customer training: inform *new* (potential) users of the potential benefits of IS use and educate *old* (continued) users on how to use IS effectively so as to maximize their confirmation and satisfaction with IS use.

Comparing the above results with prior TAM-based studies of IS acceptance, some interesting patterns emerge. Perceived usefulness was a stronger predictor of acceptance intention in TAM than attitude (Davis et al. 1989; Taylor and Todd 1995), while satisfaction was the stronger predictor of continuance intention in this study than perceived usefulness. Perceived usefulness is a cognitive belief, while attitude and satisfaction both reflect user affect (pre- and post-acceptance

Further, satisfaction also may be the key to explaining the IS acceptance-discontinuance anomaly (user discontinuance of IS after its initial acceptance), a little-understood phenomenon in IS use research. TAM, which predicts user intention based on perceived usefulness and attitude, cannot explain this anomaly satisfactorily, unless either or both determinants change from positive

to negative from pre-acceptance to post-acceptance phases. Because satisfaction was the stronger predictor of continuance intention (explaining 32% of intention variance) relative to perceived usefulness (the direct and indirect effects of perceived usefulness jointly explained 10% of the intention variance) in this study, users dissatisfied with IS use (due to disconfirmation of expectation) may discontinue IS use, despite having positive perceptions of its usefulness. In other words, dissatisfaction, and not perceived usefulness, is the necessary condition for IS discontinuance. Future studies that extend TAM into continuance contexts should, therefore, integrate satisfaction and its antecedents (e.g., confirmation) with existing TAM constructs to provide a better understanding of this anomaly.

Explaining Satisfaction with IS Use

Satisfaction with IS use was predicted primarily by users' confirmation of expectation from IS use and secondarily by their perceived usefulness of initial IS use ($R^2 = 28\%$ and 5% respectively). However, because these determinants jointly explain only 33% of the satisfaction variance, IS satisfaction may have additional salient predictors than those identified using the ECT lens.

As expected from ECT, confirmation was a stronger predictor of satisfaction than perceived usefulness in this study. Confirmation is a new construct in IS use research. Conceptualizing this construct and validating its effect on IS continuance intention (via satisfaction) are two contributions of this study. The larger effect size of confirmation, relative to perceived usefulness, suggests that users view realizing their expectation as being more salient than instrumentality of IS in forming affect and intention about IS continuance. Confirmation also had a significant positive effect on perceived usefulness, suggesting that user perception of IS instrumentality may also be adjusted by their extent of confirmation. While prior TAM-based studies suggest temporal changes in perceived usefulness, this study provides some insight on possible causes underlying such changes.

Noteworthy in this context are the similarities and differences between confirmation and service quality (SERVQUAL⁵) constructs in the marketing literature (Parasuraman et al. 1988). Both confirmation and SERVQUAL relate to a customer's evaluation of the expectation-performance discrepancy. Nonetheless, they differ on several counts. First, SERVQUAL applies only to services, while confirmation applies to both products and services. Second, expectation in SERVQUAL is anchored to a "desired" level based on a general understanding of the overall class of service, rather than a reasonable service-specific level for confirmation. Desires congruency is substantially different from expectation congruency (confirmation) in their magnitudes and satisfaction effects (Spreng and Olshavsky 1993). Third, SERVQUAL is an inferred confirmation scale. Hence, it suffers from the limitations of inferred confirmation (consistency bias, ceiling or floor effect, and low reliability) discussed earlier. In contrast, the perceived confirmation scale (typical of confirmation) is not subject to these limitations. Fourth, adaptations of SERVQUAL to IS contexts (e.g., Pitt et al. 1995) have been employed in circumstances where users are well aware of the service provider's hardware, physical facilities, and employees. Thus, they can make an informed judgment on items such as whether IS has up-to-date hardware and software, IS employees are well-dressed and neat in appearance, IS insists on error-free records, and so forth. These items are not applicable to most e-commerce services, given their remote and anonymous nature. The above issues motivated the construction of a new confirmation scale for this study.

⁵SERVQUAL is a 45-item measure of service quality in which consumers assess their expectation prior to service (via 22 items), perceived performance after the service (via another 22 items), and a single-item measure of overall service quality. The 22 items tap into five dimensions of service quality: tangibles (e.g., physical facility, equipment, appearance of personnel), reliability (ability to perform promised service dependably and accurately), responsiveness (willingness to help customers), assurance (employees' knowledge and ability to inspire confidence), and empathy (caring, individualized attention). SERVQUAL is computed in terms of the difference scores between the two 22-item pairs, plus the overall quality item.

Confirmation is a cognitive belief (the extent to which users' expectation of IS use is realized during actual use) derived from prior IS use. In addition, it influences subsequent IS use via the satisfaction (affect) and intention constructs. Such belief-affect-intention-behavior-belief causality suggests the presence of feedback loops, whereby users' beliefs, affect (satisfaction), and intention are continually refined and modified from their initial acceptance to long-term continuance or discontinuance. Such feedback is also evident in other contexts like the link between user participation (behavior) and involvement (affect) in system development (Hartwick and Barki 1994). Otherwise, it has received little theoretical attention thus far. Understanding such complex and dynamic aspects of IS use motivations, although beyond the scope of the current study, represents an interesting and potentially fruitful area for future research.

Limitations of the Study

This study suffers from several limitations. First, given the low response rate, the results may be influenced by non-response bias. Operational limitations prevented the researcher from polling a section of non-respondents to test for this bias. However, sample demographics (age and income level) were compared with "average" OBD customers, as provided by this online bank. Difference of means tests found that respondents did not differ significantly in age or income level from the target population. Therefore, bias is unlikely.

Second, the novelty associated with an online mode of data collection may have biased the survey responses. A single item check for this novelty revealed that all respondents were comfortable with online surveys (in varying degrees). In addition, 94% of the respondents had earlier filled out online forms, suggesting the absence of novelty effect.

Third, because respondents were current (and continuing) users of OBD, they may be biased in their perceptions, in contrast to OBD discontinuers. Even though discontinued users could not be contacted to test for this bias, the raw data

shows that individual ratings on each of the three continuance intention items ranged from 1 to 7. Thus, some respondents demonstrated an intent to discontinue OBD use. Given that online banking is still in its infancy, it may be reasonably expected that some of these intended discontinuers would eventually discontinue OBD use, which would alleviate the above bias.

Fourth, because survey respondents had used OBD between two and 36 months at the time of the survey, one may question whether perceptions of recent IS acceptors were systematically different from those of earlier acceptors (as suggested by Rogers 1995). As an approximate test of this bias, the sample was divided into two (early and later) groups via a median split. The research model was then run separately for each group. Despite minor differences in model fit and path coefficients, the overall pattern of results was similar across both groups. Even if earlier acceptors differed from later adopters on certain dimensions (e.g., innovativeness), such differences do not appear to influence their continuance perceptions significantly.

Finally, an ideal empirical design for testing ECT would be a longitudinal comparison of customers' pre-acceptance and post-acceptance perceptions, in order to faithfully capture the complex, dynamic interrelationships between acceptance and continuance decisions. However, the cross-sectional nature of this study restricted such temporal comparisons. Interesting issues such as changes in perceived usefulness and attitude across acceptance and continuance phases were not examined. These represent potential ways of extending the current research.

Conclusions

The goal of this paper was to identify salient determinants of IS continuance intention and to understand how they influence the dependent variable. Toward that goal, ECT was adapted from the consumer behavior literature and integrated with prior IS use research to theorize a model of IS continuance. Data collected from a

field survey of online banking users provided empirical support for the proposed model. The results indicate that while post-acceptance usefulness perception continues to influence users' continuance intention, user satisfaction with prior use has a relatively stronger effect on the dependent variable. User satisfaction, in turn, is determined primarily by users' confirmation of expectation from prior use and secondarily by perceived usefulness. Further, confirmation also has a significant influence on post-acceptance perceived usefulness. Noteworthy contributions of the study include drawing attention to the substantive differences between acceptance and continuance behaviors, theorizing and validating one of the earliest models of IS continuance, integrating confirmation and user satisfaction constructs within our current understanding of IS use, conceptualizing and creating an initial scale for measuring IS continuance, and offering an initial explanation for the acceptance-discontinuance anomaly.

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Appendix

Scale Items and Exploratory Factor Analysis

Scale Item	Factor Loadings ^a			
	1	2	3	4
<i>IS continuance intention:</i>				
CI1 I intend to continue using OBD rather than discontinue its use.	.117	.027	-.030	.699
CI2 My intentions are to continue using OBD than use any alternative means (traditional banking).	.040	-.016	.020	.790
CI3 If I could, I would like to discontinue my use of OBD (<i>reverse coded</i>).	-.044	.055	.063	.764
<i>Satisfaction:</i>				
How do you feel about your overall experience of OBD use: S1 Very dissatisfied/Very satisfied.	.759	.071	.032	-.033
S2 Very displeased/Very pleased.	.626	-.046	.076	.159
S3 Very frustrated/Very contented.	.829	-.007	-.034	.023
S4 Absolutely terrible/Absolutely delighted.	.735	.019	.044	.010
<i>Perceived usefulness:</i>				
PU1 Using OBD improves my performance in managing personal finances.	.097	.834	-.021	-.063
PU2 Using OBD increases my productivity in managing personal finances.	-.050	.809	.040	.027
PU3 Using OBD enhances my effectiveness in managing personal finances.	.058	.784	-.034	-.023
PU4 Overall, OBD is useful in managing personal finances.	-.087	.721	.054	.132
<i>Confirmation:</i>				
C1 My experience with using OBD was better than what I expected.	-.051	.019	.772	.051
C2 The service level provided by OBD was better than what I expected.	-.047	-.018	.754	.023
C3 Overall, most of my expectations from using OBD were confirmed.	.056	.011	.783	-.078
Eigenvalue	6.201	1.819	1.410	1.008

^aExploratory factor analysis (principal components with direct oblimin rotation).

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