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What factors influence auditors' use of computer-assisted audit techniques?☆,☆☆

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ABSTRACT

To meet the challenges of rapid advances in client technology, audit standards urge auditors to use computer-assisted audit tools and techniques (CAATs). However, recent research suggests that CAAT use is fairly low. This paper uses the Unified Theory of Acceptance and Use of Technology (UTAUT) to identify and then examines factors potentially influencing auditors' use or non-use of CAATs. Examining auditor use of CAATs is important because CAATs hold out the promise of improving audit efficiency and effectiveness. Data was obtained from 181 auditors from Big 4, national, regional, and local firms. Results indicate that outcome expectations, the extent of organizational pressures and technical infrastructure support influence the likelihood that auditors will use CAATs.

1. Introduction

While the use of information technology (IT) in the business world has grown exponentially in the past two decades, the extent to which auditors have responded in kind remains an empirical question (Arnold & Sutton, 1998; Curtis & Payne, 2008; Kotb & Roberts, 2011). CAATs are tools and techniques employed by auditors to extract and analyze client data (Braun & Davis, 2003). CAATs hold the promise of enhanced audit effectiveness and efficiency (Zhao, Yen, & Chang, 2004, 389). For example, CAATs enable auditors to test 100% of the population rather than a sample (AICPA, 2001; Curtis & Payne, 2008; Singleton, 2011) or to select sample transactions meeting specific criteria to obtain evidence about control effectiveness (AICPA, 2006; PCAOB, 2010c). Recent audit standards encourage auditors to adopt CAATs to improve audit efficiency and effectiveness (AICPA, 2001, 2002a, 2002b, 2002c, 2006; PCAOB, 2007, 2010a, 2010b). Despite the current emphasis on CAATs, research suggests that auditors do not frequently and systematically use CAATs (Debreceny, Lee, Neo, & Toh, 2005; Kalaba, 2002; Liang, Lin, & Wu, 2001; Payne & Curtis, 2010; Shaikh, 2005).

Information systems researchers note that technology cannot improve performance if it is not used (Davis, Bagozzi, & Warshaw, 1989; Venkatesh, Morris, Davis, & Davis, 2003). Further, information systems research has developed many theoretical models to predict user acceptance and use of IT. One important model is the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003). We modified UTAUT for our research to conform to a financial audit context. UTAUT integrates several previously accepted theoretical models to assess the likelihood of success for new technology introductions. Understanding the drivers of acceptance/rejection allows one to proactively design interventions (Venkatesh et al., 2003).

UTAUT proposes that four factors influence user acceptance: (1) user expectations about systems' performance (i.e., performance expectancy), (2) users' perceptions about the effort needed to use the new system (i.e., effort expectancy), (3) users' perceptions whether individuals important to them encourage system use (i.e., social influence), and (4) users' expectations regarding the existence of an organizational and technical infrastructure to support system use (i.e., facilitating conditions). Arguably, since larger audit firms are more likely to audit clients with highly complex financial reporting systems, we examine whether factors that influence CAAT use may differ based on firm size (Ahmi & Kent, 2013; Cheney, 2004; Lawrence, Minutti-Meza, & Zhang, 2011).

We obtained data from 181 auditors representing Big 4, national, regional, and local firms. Our results provide evidence that CAAT use may be dependent on predictable cost effectiveness tradeoffs. Implications of our findings are that to increase CAAT use, audit firms should improve employee education that emphasizes how CAATs can operationally

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improve audit efficiency and performance. Our study can be differentiated from related studies on several dimensions. First, prior studies were focused more on the prevalence of CAATs rather than the underlying reasons for their use or non-use (e.g., Braun & Davis, 2003; Debreceny et al., 2005; Lovata, 1990). Second, research has often assessed only a limited number of CAATs using rather narrow participant groups (e.g., Mahzan & Lymer, 2008). In contrast, our study utilizes 181 auditors with varying levels of experience from Big 4, national, regional, and local firms and examines a larger set of CAATs. This is important given that results have been shown to vary based on audit and IT expertise, particularly as it relates to effort expectancy (EE) (Diaz & Loraas, 2010; Mahzan & Lymer, 2008). Third, prior research (e.g., Curtis & Payne, 2008; Diaz & Loraas, 2010; Payne & Curtis, 2010) has used hypothetical experimental cases within the context of restrictive time budgets. The results of these prior studies may not generalize to actual CAAT use. Given these concerns, our study is based on *actual* CAAT use related to individual auditors' own previous experience with selected clients.[1]

2. Background and hypotheses development

2.1. Prior CAAT research

Prior CAAT research has primarily been descriptive and has focused on the Audit Command Language (ACL), a commercially available CAAT. For instance, Braun and Davis (2003) surveyed governmental auditors regarding their use of ACL. They found that while participants perceived the potential benefits associated with ACL, they displayed a lower confidence in their technical abilities to use ACL. Similarly, Pennington, Kelton, and DeVries (2006) suggest that auditors resist the use of ACL when they perceive that the task at hand is too complex and that adequate training has not been provided. On the other hand, Debreceny et al. (2005) interviewed external auditors in Singapore and found they often did not adopt CAATs because of their lack of knowledge of CAATS; they defended their non-use of CAATS arguing it was inapplicable to the nature of testing the financial statement assertions or the extent or quality of computerized internal controls.

Three recent studies examining behavioral intentions to use CAATs have utilized a modified UTAUT (Curtis & Payne, 2008; Mahzan & Lymer, 2008; Payne & Curtis, 2010). Curtis and Payne (2008) conducted an experiment with audit seniors who responded to a hypothetical case involving different budget horizons and knowledge (or no knowledge) of a superior's preferences. The results indicated that these auditors were more likely to implement new software if they are given longer-term budget and evaluation periods and a superior who favors implementation. Payne and Curtis (2010) surveyed a similar subject pool of audit seniors and measured their responses to a hypothetical audit engagement that included budget information and a description of the additional hours required to implement new software. Their results revealed that performance expectancy, effort expectancy, and facilitating conditions are positively related to intent to adopt substantive testing software. Finally, Mahzan and Lymer (2008) extend the UTAUT to the internal audit domain and find that performance expectancy and facilitating conditions influence internal auditors' intention to adopt CAATs.

2.2. Role of CAATs in the audit process

Although CAATs may not be widely used in practice (Debreceny et al., 2005; Liang et al., 2001; Payne & Curtis, 2010; Shaikh, 2005), audit standards suggest that their use may improve audit efficiency and effectiveness. SAS No. 99 encourages auditors to use CAATs to evaluate fraud risks, identify journal entries, and evaluate inventory existence and completeness (AICPA, 2002b). PCAOB risk standards (AS Nos. 8–15) suggest that auditors use CAATs to select sample transactions from key electronic files, sort transactions with specific characteristics, test an entire population instead of a sample, and obtain evidence about control effectiveness (PCAOB, 2010c). Furthermore, standards encourage auditors to use CAATs to check the accuracy of electronic files and re-perform selected procedures such as aging of accounts receivable (AICPA, 2001). The standard on risks of material misstatement (PCAOB, 2010a) suggests that auditors may respond to an increase in fraud risk by using CAATs to obtain more evidence by testing all items in the account of interest. Finally, the standard on evaluating audit results cautions auditors that situations where clients are unwilling to facilitate access to key electronic files for testing through CAATs may suggest that their assessment of fraud risks may need to be revised (PCAOB, 2010b).

While regulators and audit standards encourage the use of CAATs, prior research indicates that CAAT use may be lower than expected (Carmichael, 2004; Debreceny et al., 2005; Kalaba, 2002; Liang et al., 2001; Payne & Curtis, 2010). In the following section, we discuss factors included in the UTAUT model that may explain why auditors may be reluctant to use CAATs.

2.3. UTAUT theoretical model

Auditor acceptance of CAATs may be influenced by both firm resources and individual user perceptions (Payne & Curtis, 2010). Prior information systems research suggests that even when sufficient resources exist to purchase IT, users may not accept the new IT (Davis, 1989). The culture of the public accounting firm or office may variously encourage or create impediments to the adoption of new technologies by audit teams (Vendrzyk & Bagranoff, 2003). Thus, our study attempts to examine these factors that influence individual auditor use of CAATs. To do so, we adopt the UTAUT model (Venkatesh et al., 2003) because it incorporates elements of several prominent information systems theoretical models that predict use including the technology acceptance model (TAM) (Davis, 1989), theory of planned behavior (Ajzen, 1991; Taylor & Todd, 1995), innovation diffusion theory (Moore & Benbasat, 1991), and social cognitive theory (Compeau & Higgins, 1995). UTAUT is designed for complex and sophisticated organizational technologies (Venkatesh et al., 2003, 3); and, the UTAUT has been shown to explain up to 70% of variance in intention to use technology, outperforming each of the aforementioned specified theoretical models (Venkatesh et al., 2003).

The UTAUT proposes that three factors (i.e., performance expectancy, effort expectancy, and social influence) predict behavioral intention. Further, facilitating conditions and behavioral intention may influence IT acceptance. We use a modified version of the UTAUT model based on recent research (e.g., Curtis & Payne, 2008; Mahzan & Lymer, 2008; Payne & Curtis, 2010). That is, we investigate if performance expectancy, effort expectancy, social influence, and facilitating conditions influence actual CAAT use.

2.4. Factors influencing auditors' use of CAATs

Performance expectancy refers to 'the degree to which an individual believes that using the tool will help him or her better achieve desired outcomes' (Venkatesh et al., 2003, 23). CAATs may assist auditors in meeting audit time budget since CAATs reduce the number of hours spent conducting tests of controls and substantive testing and thereby improve audit efficiency. Prior research suggests that the perceived usefulness of technology is the single most significant predictor of technology acceptance for physicians (Chau & Hu, 2002) and accountants (Bedard, Jackson, Ettredge, & Johnstone, 2003; Loraas & Wolfe, 2006). Thus, we expect that performance expectancy will positively influence CAAT use.

[1] The method we used to capture data from auditors' *selected clients* is similar to that utilized by Gibbins, Salterio, and Webb (2001), Nelson, Elliott, and Tarpley (2002), Dowling (2009), and Brazel, Carpenter, and Jenkins (2010).

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H1. Performance expectancy will positively influence CAAT use.

Effort expectancy refers to 'the degree of ease associated with the use of the tool' (Venkatesh et al., 2003, 26). Venkatesh et al. (2003) argue that effort expectancy is expected to be more salient in the early stages of a new behavior, when process issues represent hurdles to overcome and later become supplanted by instrumentality concerns. Payne and Curtis (2010) note that since auditors may not only make the decision to adopt technology but also to be responsible for implementing the technology, the effort involved with technology adoption may be more salient to auditors than to other IT professionals. Thus, Payne and Curtis (2010) argue that effort expectancy will be associated with behavioral intention.

H2. Effort expectancy will be positively influence CAAT usage.

Social influence may be defined as 'the degree to which an individual perceives that important others believe he or she should use the new tool' (Venkatesh et al., 2003, 27). In an audit context, we expect that the greater the degree to which auditors perceive that their direct managers support CAAT usage, the more likely auditors are to adopt CAATs. Loraas and Wolfe (2006) find that support from peers and encouragement from supervisors positively influences behavioral intention. Thus, we predict that social influence will positively influence CAAT usage.

H3. Social influence will positively influence CAAT usage.

Facilitating conditions are defined as 'the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the tool' (Venkatesh et al., 2003, 29). In an audit context, this infrastructure may involve audit firms providing appropriate CAAT resources and computer support to their employees such as specialized instruction, support center, hotline, and/or use guidelines (Thompson, Higgins, & Howell, 1991). Thus, we predict that facilitating conditions will positively influence CAAT use.

H4. Facilitating conditions will positively influence CAAT use.

3. Method

3.1. Participants

We collected data from two sources. One author attended an American Institute of Certified Public Accountants (AICPA) training seminar to obtain responses from 109 auditors employed by local, regional, and national CPA firms. We also contacted local offices of each Big 4 firm and one national firm. From these contacts, we obtained responses from 72 auditors.[2] As shown in Table 1, participants included 181 auditors from Big 4, national, regional, and local firms from geographically different regions of the U.S. Respondents' average age was 36.5 years, with an average of 12.7 years of audit experience.[3] More than 83% of participants indicated that they had at least an intermediate level of IT expertise. Participants worked for a variety of firms; 31.1% were employed by Big 4 firms, 17.5% by national firms, 14.7% by regional firms, and 36.7% by local firms. The highest education level for a significant majority (82.48%) was a bachelor's degree. Almost all of the respondents (97.25%) held CPA certificates. The majority of the respondents (71.0%) were male.

Table 1
Participant demographics.

	Frequencies	Mean or percent (std. dev.)
Years as an external auditor[a]		12.7 (9.4)
Age[a]		36.5 (10.0)
Highest education level[a]		
Bachelor's degree	149	82.8%
Master's degree	29	16.1%
Coursework beyond master's degree	2	1.1%
Certification[a, b]		
Certified internal auditor	1	
Certified public accountant	156	
Certified information systems auditor	0	
Certified management accountant	1	
Certified financial executive	8	
Certified financial planner	0	
Other certification	1	
Gender[a]	M = 127	71.0%
	F = 52	29.0%
Audit firm size[a]		
Big 4	55	31.1%
National	31	17.5%
Regional	26	14.7%
Local	65	36.7%
IT expertise[a]		
Novice	30	16.7%
Intermediate	127	70.5%
Expert	23	12.8%

[a] One or more participants did not answer question.
[b] Participants could list more than one certification.

3.2. Instrument development and validation

Respondents completed the modified UTAUT questions as part of a broad field-based instrument examining audit technology and procedure usage. Given that Venkatesh et al. (2003) found that self-efficacy and anxiety do not impact technology acceptance, we elected to exclude questions regarding self-efficacy and anxiety from our field-based instrument due to parsimony concerns. We measure the impact of IT at the individual level (see Fischer, 1996). An advantage of this approach is that we can assess the IT auditors actually use, instead of inferring this from firm policy data.

To increase construct validity (Cook & Campbell, 1979; Shadish, Cook, & Campbell, 2002), we conducted two rounds of pilot testing. First, four researchers with significant audit and systems knowledge examined the case instrument. The revised instrument was then pilot tested with eight auditors from four firms varying in sizes from Big 4, national, regional, to local firms. The average audit experience for pilot study participants was 5.4 years.

Pilot testing provided us feedback on three certain instrument design issues. First, we initially considered asking participants if they used each audit procedure in a *typical* audit. However, pilot study participants indicated that given the wide diversity of client IT, that they had difficulty identifying specific CAAT usage for their *typical* client.[4] Therefore, we asked participants to select one client with highly computerized systems and indicate if they used each CAAT for that *selected* client.[5] This is similar to the method used by Gibbins et al. (2001), Nelson et al. (2002), Dowling (2009), and Brazel et al. (2010).

Second, despite the wide diversity of client IT, pilot test participants had significantly less difficulty rating CAAT importance for their *typical*

[2] Analysis of responses gathered during the AICPA training seminar and those we received directly from local offices revealed no specific patterns of differences.
[3] The demographics of our respondents are similar to the demographics of participants in recent studies by Vendrzyk and Bagranoff (2003) and Greenstein and McKee (2004).
[4] One participant summarized the issue as follows: "My clients range from small firms with basic general ledger systems to organizations that have adopted enterprise planning systems. Asking me whether (or even the extent to which) I use a specific audit procedure, such as CAATs to evaluate inventory existence and completeness, in a typical audit does not make sense."
[5] Participants indicated that they either use or do not use each audit procedure. Rating the extent of audit procedure usage for the *selected* client was difficult and of questionable value. Therefore, our audit procedure usage measure is dichotomous.

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Table 2
CAAT usage percentage in selected client and perceived importance means in typical client.
Source of table is Janvrin, Bierstaker, and Lowe (2009).

CAAT	Reference in standard	Usage in *selected* client number	Usage in *selected* client percent[a]	Importance in *typical* client[b] (std dev)
• Evaluate fraud risks (FraudCAAT)	AU 316.52	Yes = 64 No = 105	37.87	3.57 (2.42)
• Identify journal entries and other adjustments to be tested (JECAAT)	AU 316.64	Yes = 83 No = 86	49.11	3.99 (2.53)
• Check accuracy of electronic files (AccCAAT)	AU 308.33	Yes = 92 No = 76	54.76	4.16 (2.40)
• Re-perform procedures (i.e., aging of accounts receivable, etc.) (RePerfCAAT)	AU 308.34	Yes = 69 No = 98	41.32	3.69 (2.29)
• Select sample transactions from key electronic files (SampleCAAT)	AU 327.19	Yes = 87 No = 81	51.79	4.04 (2.43)
• Sort transactions with specific characteristics (SortCAAT)	AU 327.19	Yes = 83 No = 85	49.40	4.04 (2.39)
• Test an entire population instead of a sample (PopCAAT)	AU 327.19, AU 327.61	Yes = 59 No = 108	35.33	3.35 (2.34)
• Obtain evidence about control effectiveness (ContEffCAAT)	AU 327.27	Yes = 60 No = 109	35.50	3.52 (2.40)
• Evaluate inventory existence and completeness (InvCAAT)	AU 316.54	Yes = 60 No = 107	35.93	3.58 (2.48)

[a] Percent of participants who used CAAT when auditing a *selected* client with highly computerized transactions and financial reporting systems in the past year.
[b] Participants rated the importance of each CAAT for their audit of a *typical* client with highly computerized transaction and financial reporting system on a scale of 1 (not important) to 7 (very important).

client. Thus, we asked participants to rank CAAT importance for their *typical* client with highly computerized systems. Third, we asked pilot study participants several questions designed to ensure that participants were not misguided by verbiage. For example, pilot study participants provide examples of CAATs used and we made minor wording changes to ensure that respondents were able to distinguish between each type of CAAT. Further, pilot study participants reviewed the field-based instrument to ensure that wording from the audit standards and prior research was clear.

3.3. Measurement variables

Following Venkatesh et al. (2003), respondents indicated the extent to which they agreed to four statements each regarding performance expectancy, effort expectancy, and social influence using a seven point scale where 1 = strongly disagree and 7 = strongly agree. In addition, respondents answered three statements related to facilitating conditions using the same scale.[6] The responses to these questions were subsequently combined using factor analysis.

We used two measures of CAAT acceptance for each respondent. Respondents were first asked to select one audit they performed within the past year for a client with highly computerized transaction and financial reporting systems and indicate whether or not each of the nine individual CAATs suggested by recent audit standards was used on that audit. Aggregate client demographics indicate that selected client asset size varies greatly with the average reported at $1.8 billion in assets.[7] On average, participants rated the IT complexity for their selected client as 5.3 on a seven-point scale where 1 = manual processing and 7 = highly computerized financial reporting system. We totaled for each respondent the number of CAATs used on the selected audit and refer to this measure as TotalCAATUsage.

Respondents were also asked to indicate the importance of each CAAT for their *typical* audit of a client with highly computerized transaction and financial reporting systems. In our regression analysis, we refer to the average importance rating over the nine CAATs used on a *typical* audit for each respondent as AverageCAATImportance.[8]

4. Results

4.1. Descriptive statistics

The *usage* for the nine different CAATs suggested by recent audit standards is relatively low ranging from 35% of respondents who used CAATs to test an entire population (rather than a sample) to 55% of respondents who used CAATs to check the accuracy of electronic files (see Table 2).[9] Furthermore, we report the mean *importance* rating respondents assigned to each CAAT on a scale with 1 = not important and 7 = important. These importance ratings ranged from 3.35 for CAATs used to test an entire population (rather than a sample) to 4.16 for CAATs used to check the accuracy of electronic files.

Next, we examine factors that influenced auditors' selection of CAATs by collecting responses to 15 items from the UTAUT designed to predict acceptance of CAATs. Mean predictor variables, shown in Table 3, suggest that respondents assigned higher mean ratings to performance expectancy (4.09) and facilitating conditions (4.16) than to effort expectancy (3.67) and social influence (3.80).

4.2. Validation of the measurement scales

Our factor analysis involved a three step process. First, an exploratory factor analysis was performed to identify the strength of factor loadings and the potential cross-loading of individual questions on multiple constructs (see panel A of Table 4). The factor loadings for each construct exceeded 0.50 for all items except one performance expectancy response and one social influence response.[10] The four factors explained the majority of the variation in responses. Second, a confirmatory factor analysis was performed to validate construct development with the underlying theoretical expectations (see panel B of Table 4). The chi-

[6] Our respondents were employed by diverse size audit firms (i.e., Big 4, national, regional, and local). Thus, we excluded Venkatesh et al.'s (2003) third question regarding facilitating conditions (i.e., CAATs are not compatible with other systems I use) since 'other systems' may be interpreted differently by auditors from different sized firms.
[7] As expected, client asset size is statistically significantly correlated with firm size (i.e., Big 4, national, regional, and local) ($r = 0.52$; $p < 0.0001$).
[8] In our field-based instrument, respondents were asked to give specific examples of CAATs they used. We reviewed these examples to obtain additional assurance that respondents' definition of the term 'CAAT' was consistent with our definition.
[9] These results are reported in Janvrin et al. (2009) and reproduced in Table 2.
[10] We re-ran the analysis both with and without the two low constructs (i.e., PE4 and SI4) and found no major differences in results. Interestingly, these constructs were also low in Payne and Curtis (2010).

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Table 3
Predictor variable means.

Predictor variable		Mean[a]	Std. dev.	Cronbach's coefficient alpha[b]
PE1	I find computer assisted auditing techniques (CAATs) useful in my job.	4.66	1.94	0.84
PE2	Using CAATs enables me to accomplish tasks more quickly.	4.48	1.97	0.82
PE3	Using CAATs increases my productivity.	4.48	1.90	0.81
PE4	If I use CAATs, I will increase my chances of getting a raise.	2.76	1.86	0.97
Average performance expectancy		**4.09**	**1.67**	
EE1	My interaction with CAATs is clear and understandable.	3.64	1.73	0.97
EE2	It is easy for me to become skillful at using CAATs.	3.79	1.79	0.95
EE3	I find CAATs easy to use.	3.56	1.73	0.93
EE4	Learning to operate CAATs is easy for me.	3.71	1.79	0.94
Average effort expectancy		**3.67**	**1.66**	
SI1	People who influence my behavior think that I should use CAATs.	3.71	2.00	0.86
SI2	People who are important to me think that I should use CAATs.	3.70	1.98	0.86
SI3	Our firm senior managers have been helpful in the use of CAATs.	3.39	1.97	0.89
SI4	In general, our firm has supported the use of CAATs.	4.41	1.98	0.92
Average social influence		**3.80**	**1.76**	
FC1	I have the resources necessary to use CAATs.	4.29	1.92	0.75
FC2	I have the knowledge necessary to use CAATs.	3.98	1.88	0.84
FC3	A specific person (or group) is available for assistance with CAATs difficulties.	4.20	2.26	.090
Average facilitating conditions		**4.16**	**1.82**	

[a] Participants were asked to indicate the extent to which they agreed from 1 (strongly disagree) to 7 (strongly agree) with each statement.
[b] Cronbach coefficient alpha with deleted variables (PE4 and SI4).

square value is close to zero and the probability level for the chi-square is greater than 0.05. The comparative fix index (CFI) (0.89), non-normed index (NNI) (0.86), and NFI (0.87) values meet the acceptable criteria for acceptable model fit.

Third, scale reliability was determined based on Cronbach's alpha. The results indicated that Cronbach's alpha reliability coefficients met the 0.70 threshold for acceptability (Nunnaly, 1978) as the scale reliabilities were high for performance expectancy (0.90), effort expectancy (0.96), social influence (0.91), and facilitating conditions (0.88) (see panel B of Table 4).

4.3. Tests of the model

Following Venkatesh et al. (2003), we considered using structured equation modeling. We tested the modified UTUAT model where TotalCAATUsage/AverageCAATImportance is a function of Performance expectancy (PE), Effort expectancy (EE), Social influence (SI), and Facilitating conditions (FC).[11] Similar to Venkatesh et al. (2003), the structured equation model failed to find convergence due to small sample size. Thus, we elected to use regression as our statistical analysis method.

Our direct effects regression model is defined as: TotalCAATUsage/AverageCAATImportance = f(Performance expectancy (PE), Effort expectancy (EE), Social influence (SI), and Facilitating conditions (FC)). In the first model, we examine the effects of four constructs from UTAUT on auditor usage of CAATs (TotalCAAT Usage). In the second model, we examine the effects of these four constructs on how auditors rate CAAT importance (AverageCAATImportance). In both models, performance expectancy (PE) represents the degree to which a participant believes that using CAATs will help him/her better attain significant rewards. Effort expectancy (EE) refers to the degree of ease a participant associates with using CAATs. Social influence (SI) represents the degree to which a participant perceives that important individuals such as audit firm management believe he/she should use CAATs. Finally, facilitating conditions (FC) refers to the degree to which a participant believes the audit firm has the organizational and technical infrastructure to support use of CAATs.

As shown in Table 5, Performance expectancy is significant at the $p < 0.05$ level for both models. Furthermore, Facilitating conditions is significant at the $p < 0.01$ level for TotalCAATUsage and at the $p < 0.05$ level for AverageCAATImportance. Both models have statistically significant overall F-values. The first model (i.e., TotalCAATUsage) has an adjusted R^2 of 37.9%. The second model (i.e., AverageCAATImportance) has an adjusted R^2 of 42.9%.

4.4. Additional analysis

Prior research indicates that IT acceptance varies by gender, age, and experience (Morris & Venkatesh, 2000; Venkatesh & Morris, 2000). For example, men tend to adopt IT more often when they perceive it to be useful to their jobs. In contrast, perceptions of ease of use and subjective norms are more likely to drive women's IT adoption (Venkatesh & Morris, 2000). Younger workers are more likely to be influenced by attitude toward using technology whereas older workers are more strongly influenced by subjective norms and perceived behavioral control (Morris & Venkatesh, 2000). Also, experience may influence IT acceptance as more experienced auditors are more likely to have multiple avenues for help and support throughout the firm, thereby removing impediments to sustained usage (Bergeron, Rivard, & De Serre, 1990). Furthermore, prior research suggests that firm size may influence CAAT acceptance since larger firms are more likely to have infrastructure available for CAAT training and support (Janvrin et al., 2009).

To examine whether gender, age, audit experience, or firm size impact our results, we added these variables as covariates to the models shown in Table 5. The results indicated that gender, age, and audit experience were not significant determinants of CAAT acceptance for either dependent variable (i.e., TotalCAATUsage or AverageCAATImportance).[12] However, firm size was statistically significant for both dependent variables (i.e., TotalCAATUsage $p = 0.0192$ and AverageCAATImportance $p = 0.0012$). Contrast analysis indicates that auditors employed by Big 4 firms are more likely to rate Performance expectancy and Facilitating conditions higher than those employed by smaller firms ($F = 7.99$, $p = 0.0053$ for TotalCAATUsage and $F = 9.02$, $p = 0.0031$ for AverageCAAT Importance).

[11] In addition, we tested Venkatesh et al.'s (2003) two stage model where Behavioral intention (BI) is a function of Performance expectancy (PE), Effort expectancy (EE), and Social influence (SI) and TotalCAATUsage/AverageCAATImportance is a function of Facilitating conditions (FC) and Behavioral intention (BI). Similar to Venkatesh et al. (2003), the structured equation model failed to find convergence due to small sample size.

[12] UTAUT predicts that (1) gender will impact Performance expectancy, Effort expectancy, and Social influence, (2) age will impact all four UTAUT components, and (3) audit experience will impact Effort expectancy, Social influence, and Facilitating conditions. We ran regression models to test each prediction. In each model, gender, age, and audit experience were not statistically significant.

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Table 4
Factor analysis.

Panel A: factor loadings from exploratory factor analysis

	Direct effects			
Survey items (see Table 3)	PE	EE	SI	FC
PE1	0.828			
PE2	0.956			
PE3	0.940			
PE4	0.231			
EE1		0.73		
EE2		0.84		
EE3		0.96		
EE4		0.91		
SI1			0.95	
SI2			0.95	
SI3			0.54	
SI4			0.40	
FC1				0.99
FC2				0.67
FC3				0.53
Eigenvalues	104.52	21.93	9.38	5.78
Percent explained	73.80	15.49	6.63	4.08
Cumulative percent explained	73.80	89.29	95.92	100.00

Panel B: factor reliability and cross-factor correlations for the confirmatory factor analysis

	Alpha[a]	Mean	Std. dev.	TotalCAATUsage	AverageCAATImportance	PE	EE	SI
TotalCAATUsage		0.43	0.37					
AverageCAATImportance		3.89	2.00	0.63				
PE[b]	0.90	4.09	1.67	0.54	0.49			
EE	0.96	3.67	1.66	0.50	0.44	0.82		
SI	0.91	3.80	1.76	0.54	0.46	0.71	0.66	
FC	0.88	4.16	1.82	0.58	0.50	0.66	0.71	0.72

TotalCAATUsage: TotalCAATUsage - Number of CAATS participant indicated he/she used when auditing a selected client with highly computerized financial reporting systems during the prior year.
AverageCAATImportance: AverageCAATImportance - Average importance rating participant gave nine CAATs when auditing a typical client with highly computerized financial reporting systems (1 = not important to 7 = very important).
PE: Performance expectancy—the degree to which participant believes that using CAATs will help him/her better attain significant rewards (1 = strongly disagree to 7 = strongly agree).
EE: Effort expectancy—the degree of ease participant associates with using CAATs (1 = strongly disagree to 7 = strongly agree).
SI: Social influence—the degree to which participant perceives that important others believe he/she should use CAATs (1 = strongly disagree to 7 = strongly agree).
FC: Facilitating conditions—the degree to which participant believes that the organizational and technical infrastructure exists to support use of CAATs (1 = strongly disagree to 7 = strongly agree).
[a] Alpha column reports the Cronbach's alpha reliability score for each construct.
[b] Each construct was extracted using factor analysis. We used oblique minimization to obtain a rotated factor solution. The final constructs are:

Furthermore, Venkatesh et al. (2003) caution that voluntary usage results may not generalize to mandatory usage settings. Also, some CAATs involve embedded audit modules and integrated test facilities that require client cooperation in order to implement. To examine whether our results are influenced by whether respondents perceived significant pressure to adopt CAATs or by client willingness to implement CAATs, we collected information regarding respondent perceptions of freedom to choose technology and client innovativeness. The mean freedom to choose technology response from our respondents to the statement, 'I have the freedom to choose what technology I will use' was 3.86 on a seven point scale where the endpoints are 1 = strongly disagree and 7 = strongly agree. The mean client innovativeness response from our participants to the statement, 'My clients are generally innovative with respect to adopting information technology' was 4.06 on a seven point scale with endpoints of 1 = strongly disagree and 7 = strongly agree. We added these variables as covariates to our models. The results indicated that neither of these variables were significant determinants of CAAT acceptance for either dependent variable (i.e., TotalCAATUsage or AverageCAATImportance).

5. Discussion and implications

Despite the rapid growth of IT in business today and encouragement from regulators, prior research suggests that CAAT adoption by individual auditors remains relatively low (Curtis & Payne, 2008; Debreceny et al., 2005; Kalaba, 2002; Liang et al., 2001). CAAT usage is important since CAATs may increase audit effectiveness and efficiency (Dowling, 2009; Dowling & Leech, 2007; Manson, McCartney, & Sherer, 2001). To obtain an understanding of factors that may impact auditor acceptance, we modified a recent technology acceptance theoretical model (UTAUT) from information systems research (Venkatesh et al., 2003) for the audit context. In contrast with other early auditing studies based on UTAUT which examine behavioral intention, we examine actual CAAT usage. Our modified model predicts that Performance expectancy, Effort expectancy, Social influence, and Facilitating conditions will influence CAAT usage.

The results obtained from 181 auditors representing Big 4, national, regional, and local firms indicate that Performance expectancy and Facilitating conditions may increase the likelihood that auditors will accept CAATs. Prior research suggests that training can be more effectively designed and targeted to particular user groups if the mechanisms of user acceptance are better understood (e.g., Bedard et al., 2003; Venkatesh & Davis, 1996). Our findings indicate that developing training programs to increase the expectations auditors hold regarding how well CAATs may improve their performance may increase CAAT usage. These programs may be particularly useful since in general, our participants assigned low importance ratings to CAATs. Furthermore, our results may encourage audit firm management to invest in additional organizational and technical infrastructure supporting CAATs, particularly for auditors that are less inclined to adopt new systems. For example, having a member of the audit team dedicated to IT support may give auditors more confidence in using CAATs. In addition, our

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Table 5
Use of CAAT: regression results.

Variables			Model 1 TotalCAATUsage			Model 2 AverageCAATImportance		
	Coef	Expected sign	β	t-Stat	Sig	B	t-Stat	Sig
Panel A: statistics for individual factors								
Intercept	β_0		−0.18			0.93		
Performance expectancy (PE)	β_1	+	0.05	2.00	*	0.34	2.22	*
Effort expectancy (EE)	β_2	–	−0.01	−0.40		−0.03	−0.18	
Social influence (SI)	β_3	+	0.03	1.51		0.11	0.92	
Facilitating conditions (FC)	β_4	+	0.07	3.43	**	0.30	2.52	*
Panel B: overall model statistics								
F-value				24.59			17.66	
Overall model p-value				<0.0001			<0.0001	
Adjusted R^2 (%)				37.9			42.9	

Model specifications:
Model 1: TotalCAATUsage $= \beta_0 + \beta_1 PE + \beta_2 EE + \beta_3 SI + \beta_4 FC$.
Model 2: AverageCAATImportance $= \beta_0 + \beta_1 PE + \beta_2 EE + \beta_3 SI + \beta_4 FC$.
Significance:
* Significant at p-value < 0.05.
** Significant at p-value < 0.01.

results suggest that audit firms could encourage CAATs usage through positive reviewer comments, bonuses, and promotion criteria.

Our findings indicate that auditors employed by Big 4 firms are significantly more likely than those employed by smaller firms to provide higher ratings for Performance expectancy and Facilitating conditions, which in turn influence their use of CAATs. Several factors may contribute to this result. First, auditors employed by Big 4 firms are more likely to audit larger clients who possess more complex IT and thus drive CAAT usage. Second, Big 4 audit firms have more resources available to them to respond to current developments and clients' needs (Gist & Davidson, 1999; Palmrose, 1986). Our findings, together with the recent growth opportunities for non-Big 4 firms due to the Sarbanes Oxley Act of 2002 (Accounting Office Management and Administration, 2005; Dennis, 2005; Rozycki, 2005) and the turnover of risky clients from the Big 4 firms to non-Big 4 firms (Cheney, 2004), may encourage smaller audit firms to expend more resources on training and infrastructure to enhance CAAT acceptance. Future research is needed to investigate resource constraints on CAATs usage by auditors at smaller firms. Moreover, future research that captures data on audit efficiency (total hours) and effectiveness (misstatements identified) is needed to investigate how both smaller and larger firms can get the most "bang for their buck" when investing in IT. It is also possible that Big 4 firms provide more incentives for auditors to use CAATs. Thus, future research could compare reward systems for using CAATs at larger and smaller audit firms.

We did not find that Social influence or Effort expectancy were significant. This may reflect the fact that in an audit context, auditors have a responsibility to gather sufficient competent evidence, so personal preferences regarding effort or social variables may have less weight than in an individual technology choice decision. These results suggest that auditors place priority on audit effectiveness when making technology usage decisions. These findings are also consistent with, and extend, other recent auditing research that has examined the UTAUT model with external auditors from a single firm using experimental methods that manipulated the UTAUT components (Payne & Curtis, 2010), as well as other survey research with internal auditors as research subjects (Mahzan & Lymer, 2008). Nevertheless, future research could examine if there are certain research methods such as experimental approaches that make some dimensions of the UTAUT model (e.g., effort expectancy) more salient as compared to other research methodology such as surveys or field studies, and if further refinement of the UTAUT model is warranted for certain variables that are significant in some studies, but not others.

Our results must be interpreted in light of certain limitations. First, due to data limitations, we asked auditors to self-report the extent of their CAAT usage. To increase construct validity, a better proxy may involve using firm data collected by monitoring CAAT usage (Devaraj & Kohli, 2003; Straub, Limayem, & Karahanna, 1995; Venkatesh et al., 2003). Second, IT usage acceptance research in MIS generally examines voluntary usage contexts. Additional research could investigate whether our findings differ in settings where voluntary versus mandatory usage is more distinct than in our study. Finally, some CAATs involve embedded audit modules and integrated test facilities that require client cooperation in order to implement. Although this variable was not a significant covariate in our study, future research is needed to identify the degree to which lack of client cooperation influences auditors' CAATs usage.

Despite these limitations, our results provide important insights into why auditors currently use (or do not use) CAATs. Given auditors' slower than expected acceptance of CAATs (Curtis & Payne, 2008; Debreceny et al., 2005; Liang et al., 2001), identifying the drivers of CAAT acceptance helps researchers and practitioners design training, marketing, and infrastructure support to encourage CAAT acceptance. Our results suggest that in the audit context, Facilitating conditions and Performance expectancy are more important than personal or social variables.

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