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THE ROLE OF CONFIRMATION IN IS CONTINUANCE THEORY: A COMPREHENSIVE META-ANALYSIS

Completed Research Paper

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Abstract

This paper provides a meta-analysis of Information Systems Continuance (ISC) theory, specifically focusing on the relationships that Confirmation has with Satisfaction, Perceived Usefulness and Continuance Intention. A comprehensive literature review for the years 2001 to 2012 revealed 75 ISC studies from 72 papers. The results of this meta-analysis indicate the robustness of ISC theory and model, with large effect sizes for the three key relationships. Moderator analyses indicate larger effect sizes for non-convenience samples (versus convenience samples) and educational/e-Learning Information Systems and personal Information Systems (versus corporate Information Systems). Implications of the results are discussed, along with implications for researchers and practitioners. Meta-analysis limitations as well as future directions for this meta-analysis are presented.

Keywords: Information Systems Continuance, Meta-analysis, Confirmation, Disconfirmation, Continuance Intention, Satisfaction, Perceived Usefulness

Introduction

This paper provides a meta-analysis of the Information Systems Continuance (ISC) theory, developed by Anol Bhattacherjee in his seminal 2001 MIS Quarterly study "Understanding Information Systems Continuance: An Expectation-Confirmation Model" (Bhattacherjee 2001b). Specifically, this meta-analysis focuses on the main antecedent in the ISC model (i.e., Confirmation) and the relationships it has with Satisfaction (SAT), Perceived Usefulness (PU) and IS Continuance Intention (CI). A total of 75 studies that include the Confirmation (CONF) construct and one or more of the other constructs were identified as pertinent to this meta-analysis.

Bhattacherjee's paper has been cited over 350 times (according to the Web of Science Database) and over 1,000 times (according to Google Scholar), indicating the importance of this theory to the field of IS. The importance of ISC theory to the field of Information Systems is also evidenced by the fact that 29 studies utilizing ISC theory (of the 75 studies contained in this meta-analysis) have been recently published (i.e., since 2010). This indicates a growing usage if ISC theory, and the need for a meta-analysis to help "synthesize [the] body of literature in a rigorous and quantitative fashion" (King and He 2005). This meta-analysis will be of interest to researchers who are considering using ISC, as it supports the relationships between CONF-SAT, CONF-PU and CONF-CI. By combining all known relevant papers, authors can utilize this meta-analysis when incorporating ISC theory in their studies as this meta-analysis can serve to provide researchers with effect sizes to support their proposed hypotheses. As noted by Glass (1976) and cited by King and He (2005), "when the literature on a topic grows and knowledge lies untapped in completed research studies, 'this endeavor (of research synthesis) deserves higher priority...than adding a new experiment or survey to the pile'" (Glass 1976; King and He 2005). The meta-analysis is a rigorous method to synthesize prior research results (King and He 2005). However, as stated by King and He "[the] meta-analysis is of great potential significance [but] inadequately applied in IS" (King and He 2005).

A search of the Association for Information Systems (AIS) top-rated IS journals for any meta-analyses (i.e., not specifically ISC theory) revealed a limited number of meta-analyses on any IS topic, indicating a gap in the IS field for relevant meta-analyses. This underutilization of meta-analyses in IS research was noted by King and He (2005). This paper begins to close this gap through a meta-analysis on the already established ISC theory. Thus this paper aims to contribute to IS theory by synthesizing the knowledge gained from the large volume of ISC studies, both published and unpublished.

A comprehensive literature search revealed only one previous meta-analysis completed on the topic if ISC theory (Islam and Mantymaki 2011). The recent Islam and Mantymaki (2011) paper utilized a smaller number of studies (i.e., 21), whereas this meta-analysis extends this significantly through the inclusion of 72 papers containing a total of 75 usable studies. Therefore, this meta-analysis aims to confirm and extend (through the inclusion of 54 additional studies) the meta-analytic findings of Islam and Mantymaki (2011), as well as explore new areas of moderation. Specifically, the research questions are as follows:

- How robust is the role played by Confirmation in ISC theory, based on the effect sizes for CONF-SAT, CONF-PU and CONF-CI? Based on the additional studies used in this meta-analysis, can the earlier results from the meta-analysis performed by Islam and Mantymaki (2011) be confirmed?

- What are the moderation effects for type of respondent (i.e., non-convenience sample versus convenience samples)? Do these results confirm the results from the Technology Acceptance Model (TAM) meta-analyses conducted by King and He (2006) and Schepers and Wetzels (2007) and the ISC meta-analysis by Islam and Mantmaki (2011)?

- What are the moderation effects of type of technology used in the studies (a moderator analysis suggested by Islam and Mantymaki (2011))? In this meta-analysis, types of technology have been categorized as personal (e.g., social networking, online shopping, etc.), corporate (e.g., knowledge management system, document management system, e-Collaboration, etc.) or educational (e.g., e-Learning, simulation games, etc.).
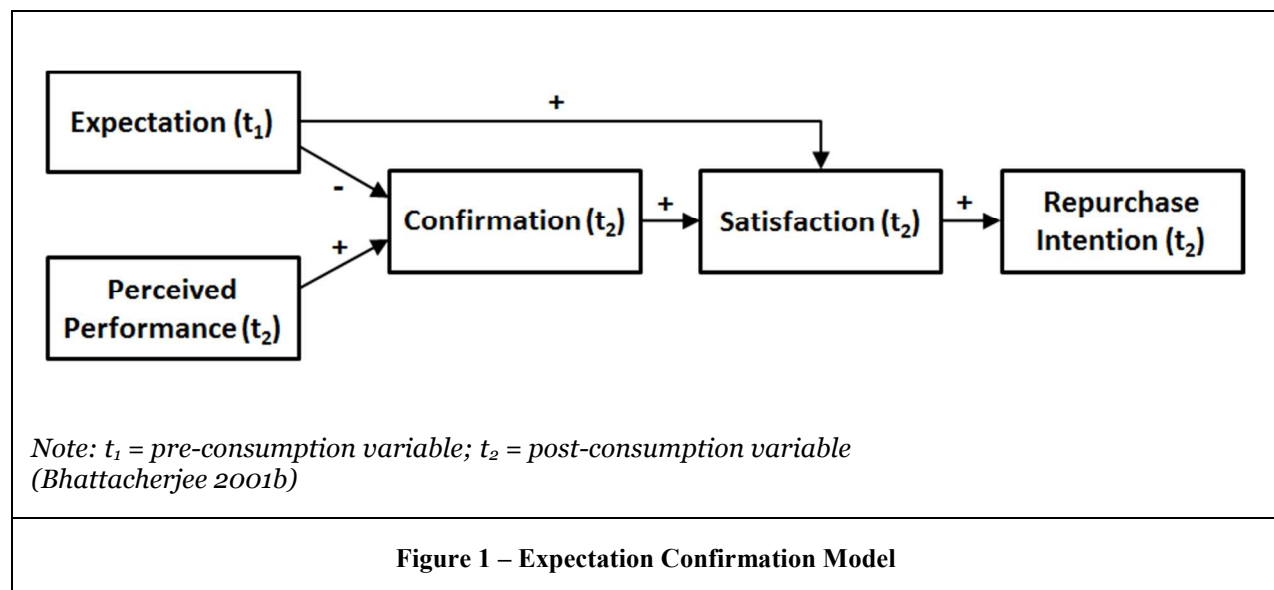
The remainder of this paper is organized as follows. First, the theoretical background of both Expectation-Confirmation and ISC theory and model and definitions of the ISC constructs are provided.

The next section outlines the methodology used in the meta-analysis, including data gathering and a discussion of potential issues with the data and the steps taken to resolve those issues. Following this are the effect size results, confidence and credibility intervals and an analysis of two potential moderators. This is followed by a discussion of the results, implications for researchers and practitioners, meta-analysis issues and limitations and future directions for this meta-analysis.

Theoretical Background, Definitions and Hypotheses

Theoretical Background

Expectation-Confirmation (EC) theory has been widely utilized and published in consumer marketing and behavior studies since introduced by Oliver (1980). Specifically, EC theory proposes that consumers form an initial expectation of a product or service prior to purchase. After purchasing and using the product, consumers form specific perceptions regarding the performance of the product or service. By then assessing this perceived performance against their initial expectations, consumers can then determine if their expectations were met or not, thus confirming (or disconfirming) their expectations. Based on the level of confirmation, consumer's satisfaction levels and intention to repurchase are formulated (Bhattacherjee 2001b). The EC model is shown in Figure 1.

Note: t_1 = pre-consumption variable; t_2 = post-consumption variable
(Bhattacherjee 2001b)

Figure 1 – Expectation Confirmation Model

In his paper, Bhattacherjee (2001b) formulated the ISC model based on EC theory as outlined above. Specifically, Bhattacherjee stated that "IS users' continuance decision is similar to consumers repurchase decision because both decisions (1) follow and initial (acceptance or purchase) decision, (2) are influenced by initial use (of IS or product) experience, and (3) can potentially lead to ex-post reversal of the initial decision." (Bhattacherjee 2001b). Bhattacherjee made two crucial theoretical extensions to adapt EC theory to an IS context:

* the IS Continuance model only examines post-consumption, and captures pre-acceptance variables (i.e., initial expectation, performance) in the confirmation and satisfaction constructs
* the IS Continuance model adds post consumption expectation confirmation through the PU construct

Based on these extensions of the original EC theory and model, Bhattacherjee developed the ISC model, shown below in Figure 2. While variations of the model have been utilized, many studies (including all of those included in this meta-analysis) remain consistent with the original ISC and include most, if not all of these four constructs.

(Bhattacherjee 2001b)

Figure 2 – IS Continuance Model
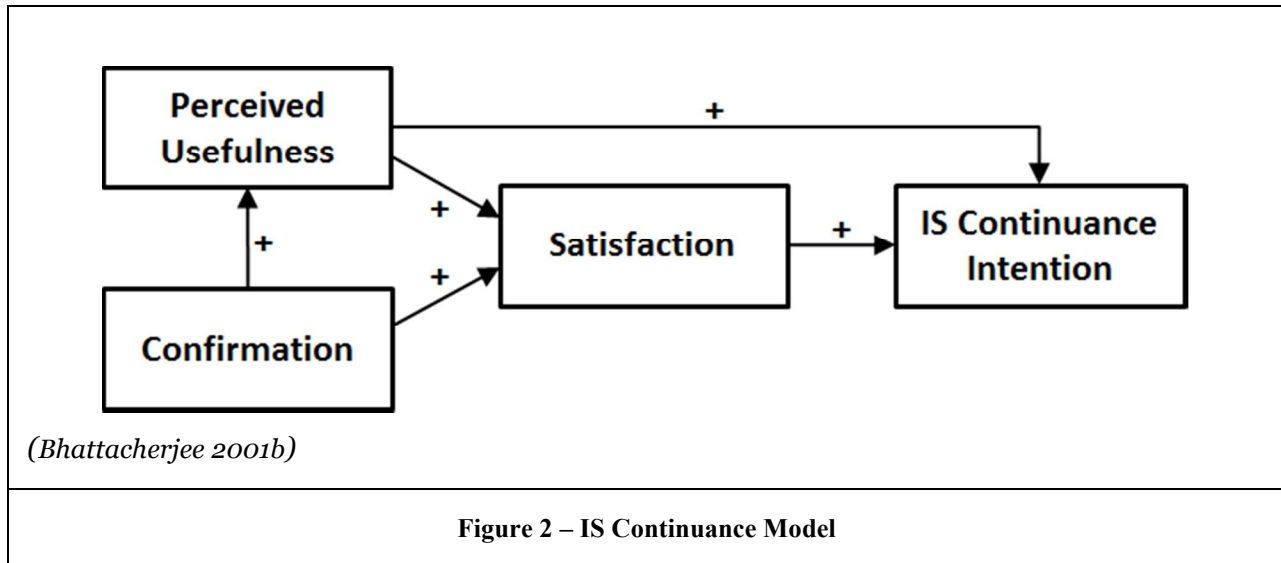
Construct/variable Definitions

The ISC constructs were succinctly defined by Bhattacherjee (2001b), which has led to these definitions and in many cases his specific measures to be utilized in numerous ISC studies. The four constructs are operationally defined as follows (Bhattacherjee 2001b):

- IS Continuance Intention – "Users' intention to continue using [IS]"
- Satisfaction – "Users' affect with (feelings about) [IS] use"
- Perceived Usefulness – "Users' perception of the expected benefits of [IS] use"
- Confirmation – "Users' perception of the congruence between expectation of [IS] use and its actual performance"

It is interesting to note that researchers tend to use Confirmation and Disconfirmation somewhat interchangeably, with the measurement scales utilized virtually the same regardless of the construct wording choice. To ensure consistency in this meta-analysis, all papers that utilized the Disconfirmation construct were carefully reviewed to ensure the measurement scale was consistent with Confirmation. All other constructs remained consistent in definitions and measurement scales among the studies utilized in this meta-analysis.

Methodology

This meta-analysis closely follows the nine steps set forth by King and He (2005) in their guidelines put forth for IS researchers to conduct a systematic meta-analysis.

Search Definitions and Restrictions

Given the focus of this meta-analysis is on the relationships that CONF has with SAT, PU and CI, all papers included in this meta-analysis were required to contain the Confirmation (or Disconfirmation) construct. There are a number of papers that include the SAT and/or PU and/or CI constructs in the absence of Confirmation, however these studies were not utilized. In addition, given this meta-analysis' focus on Confirmation specifically in ISC theory (thus eliminating earlier EC studies related to consumer marketing, etc.), searching was limited to studies published after Bhattacherjee's seminal 2001 ISC paper, as it was the first specific application of EC theory in an IS context, that also included all of the variables of interest in this meta-analysis.

Selection of Studies

A systematic procedure was followed to gather all relevant studies. Keyword, title and abstract searches were performed on all pertinent search tools/engines and databases. The search terms used were designed to retrieve as many studies as possible, which were then analyzed for inclusion in the meta-analysis. The search terms were unbounded, so that they would capture all papers which contained the word anywhere in the title, abstract or keywords. The search terms used were as follows:

- "confirmation" (to capture confirmation, expectation-confirmation)
- "disconfirmation" (to capture disconfirmation, expectation-disconfirmation)
- "continuance" (to capture continuance, IS continuance, information systems continuance, continuance intention, IT continuance, information technology continuance, technology continuance theory)

Based on an examination of the methodology contained in a previous IS meta-analysis published in a top-tier IS journal (i.e., Journal of Management Information Systems) (He and King 2008), the following four databases were searched:

- EBSCO Host Business Source Complete – This database contains references and peer-reviewed papers from over 1,300 business related journals. Other databases such as JSTOR and Scholar's Portal can be accessed through an EBSCO search.
- Social Sciences Citation Index (SSCI) – This database, accessed through Thomson-Reuters ISI Web of Knowledge contains over 2,450 social science related journals as well as over 3,500 scientific and technical journals.
- Association for Information Systems Electronic Library (AISeL) – The AISeL contains papers from the major IS conference proceedings, including International Conference on Information Systems (ICIS), European Conference on Information Systems (ECIS), Americas Conference on Information Systems (AMCIS), Pacific Asia Conference on Information Systems (PACIS), Australasian Conference on Information Systems (ACIS), Hawaii International Conference on System Sciences (HICSS) and the Bled Electronic Commerce Conference (BLED).
- Proquest/UMI Dissertations and Theses Database – This database contains doctoral dissertations / master's theses completed at accredited North American and selected European colleges and universities.

In addition, the following searches were completed to ensure thoroughness and diligence in this meta-analysis:

- Seminal paper by Bhattacherjee – As mentioned previously, a 2001 MIS Quarterly paper by Bhattacherjee (2001b) is cited by virtually every study which utilizes ISC. Therefore, a search of the papers identified through the above sources which cited Bhattacherjee's paper was completed to ensure all relevant studies were included.
- Google Scholar – A search of Google Scholar was performed to ensure that no journal articles, conference papers or theses had been missed through the previous search steps outlined above.
- Bibliographies of selected papers – As a final step, the bibliographies of the studies selected through the previously defined search process were examined to ensure all relevant studies were included.

The search outlined above yielded a total of 75 relevant studies which have been included in this meta-analysis. A thorough review of the papers was completed to ensure that conference papers and/or dissertations used in this meta-analysis were not also published in journals at a later date, to ensure that each of the 75 studies included was unique. A detailed breakdown of the type of study has been provided below in Table 1. Eleven of the 61 (or 18%) journal paper studies were from the AIS top-tier journal list (i.e. Senior Scholars' Basket of Journals), including five (or 8.2%) from the Financial Times Top Academic Journals in Business (i.e., FT-45). All conference papers were from established conference proceedings. It should be noted that the 75 relevant studies were drawn from 72 journal papers, conference papers and theses, as two of the journal papers and one of the conference proceedings contained two usable studies in a single paper/proceeding. Of these 75 studies, 46 included all four of the constructs from ISC Theory, 23

studies included three of the four constructs and six studies included two of the four constructs. All studies utilized included the Confirmation construct.

Table 1. Summary of meta-analysis studies		
Type	**Papers**	**Studies**
Journal papers	59	61
Conference papers	10	11
Dissertations / Theses	3	3
Total	72	75

Data Analysis

This meta-analysis produced 190 effect sizes from the 75 studies analyzed. To calculate the values reported in this meta-analysis, the Hunter and Schmidt meta-analysis approach was used (Hunter and Schmidt 2004; Hunter et al. 1982). For studies that did not report correlations, the conversion methods outlined by Wu and Lederer (2009) were used. The five steps performed to determine the meta-analysis effect sizes were: 1) correct the reported effect sizes for unreliability; 2) transform the effect sizes into standard scores utilizing Fisher's r-to-Z transformation; 3) weigh the effect sizes; 4) calculate the overall weighted mean effect size; and 5) convert the overall weighted mean back into un-standardized form.

Potential Issues with Included Studies

A number of the studies included in this meta-analysis had some specific potential issues which should be addressed in conjunction with reporting the results. These potential issues are noted so the reader is aware of them and the actions taken to ensure the usability and applicability of the studies for this meta-analysis. The potential issues and actions taken are detailed in Appendix 1.

Results

Effect Sizes

The meta-analysis, conducted on a random-effects basis, clearly indicates that CONF has a strong positive relationship with SAT, PU and CI, as detailed below in Table 2. Effect sizes ranged from 0.585 for CONF-PU up to 0.639 for CONF-SAT. These results somewhat confirm the findings of Islam and Mantymaki (2011), who found effects sizes of 0.57 for CONF-SAT (95% confidence interval of 0.44 to 0.70) and 0.48 for CONF-PU (95% confidence interval of 0.40 to 0.56). However, this meta-analysis, with the inclusion of a significantly greater number of studies found higher effect sizes for CONF-PU and CONF-SAT. Effect sizes for CONF-CI were not included in the study by Islam and Mantymaki (2011). Based on Cohen (1992) guidelines for *r*, each of the effect sizes found in this meta-analysis can be considered large (i.e., $r > .50$). Confidence intervals were calculated which indicate the precision of the results generated and provide the reader with ranges within which the true correlations will most likely fall. These 95% confidence intervals are provided in Table 2, and clearly show the strength of the effect sizes. It should be noted that all of the confidence intervals were significant at $p < 0.001$.

Credibility intervals, which for a random-effects model are "more critical and important than confidence intervals" (Hunter and Schmidt 2004) are provided below. Credibility values can be used to "address the question of whether moderators are operating, or, in other terms, whether the population should be broken down into subpopulations" (Whitener 1990). Following the guidelines outlined by Whitener (1990), an examination of the credibility reveals that they are sufficiently large, indicating that moderators are in operation. This conclusion is also supported by the Q-test, which indicate that the effect sizes are heterogeneous. Therefore, two moderator analyses are presented later in this paper.

Table 2 - Meta-analysis summary of effect sizes			
	CONF-SAT	**CONF-PU**	**CONF-CI**
Number of studies	73	55	62
Sample size	27,445	22,923	25,250
Average sample size	376.0	416.8	407.3
Effect size	**0.639**	**0.585**	**0.598**
Q-test for homogeneity	2,940.0	1,116.5	2,301.0
p-value for homogeneity	0.000	0.000	0.000
SD_p	0.227	0.185	0.207
95% Credibility interval	± 0.445	± 0.363	± 0.406
95% Credibility lower bound	0.194	0.222	0.192
95% Credibility upper bound	1.000[a]	0.948	1.00[a]
95% Confidence interval	± 0.013	± 0.014	± 0.014
95% Confidence lower bound	0.626	0.571	0.584
95% Confidence upper bound	0.652	0.599	0.612

SD_p = *corrected standard deviation in effect sizes*
[a] *upper bound of the credibility interval was maximized at 1.00*

Large Sample Size Influence

Within the ISC literature gathered, three studies had individual sample sizes greater than 1,000 with the sum of the sample sizes from these three studies totaling 8,711. Depending on the construct being analyzed this represents between 31.7% and 38.0% of the total sample size. Therefore, to examine the influence these large sample size studies have on the meta-analysis results, they were temporarily removed from the analysis and a comparison of the differences in the meta-analysis statistics was made. The results of this analysis, shown in Table 3 indicate that removal of these studies did increase the effect size for CONF-SAT and CONF-PU, with a smaller increase in effect size for CONF-CI. However, given the quality of the journals and conferences where these studies were published (i.e., Information Systems Journal, Decision Support Systems, Hawaii International Conference on System Science) and the relatively small impact they have on effect sizes (less than a 5% change), a decision was made to leave these large sample size studies in this meta-analysis.

Table 3. Meta-analysis summary of effect sizes (large sample size studies removed)			
	CONF-SAT	**CONF-PU**	**CONF-CI**
Number of studies	70	52	59
Sample size	18,734	14,212	16,539
Average sample size	267.6	273.3	280.3
Effect size	0.669	0.610	0.610
Δ from effect size for all studies	+0.030	+0.025	+0.012
% Δ from effect size for all studies	+4.7%	+4.3%	+2.0%

Moderator Analyses

Based on the research questions posed earlier, two moderator analyses were completed. This analysis of moderator effects was recommended by King and He (2005) who stated "The study of moderator effects often involves two stages: the detection, or exploratory analysis, of possible moderators, and the assessment, or confirmatory analysis, of theoretically suggested moderators" (King and He 2005). Given the heterogeneity of the overall sample and suspected presence of moderators (based on the Q-test and credibility interval results), a number of moderator analyses were performed to examine the potential differences between sub-groupings and determine if these sub-population samples exhibit higher levels of homogeneity. This meta-analysis completed exploratory moderator analyses that examined type of survey participants (i.e., convenience sample versus non-convenience sample) and type of IS technology (i.e., Personal versus Corporate/Business versus Educational) as potential moderators.

Participants - Convenience Samples versus Non-convenience Samples

Many research studies, including those in IS often utilize convenience samples (i.e., typically student samples who are justified as surrogates for actual users), and therefore this meta-analysis tested whether this factor influenced effect sizes. As noted above, one of the research questions this meta-analysis attempts to answer is whether effect sizes are significantly different for convenience samples versus non-convenience samples. Unfortunately there is limited literature that details the role that non-convenience versus convenience samples plays in the intention to adopt, adoption, use and continued use of technology.

The Technology Acceptance Model (TAM) meta-analysis by Schepers and Wetzels (2007) found stronger relationships between the TAM constructs for student samples (i.e., a category similar to convenience samples) than non-student samples (i.e., a category similar to non-convenience samples). Another TAM meta-analysis by King and He (2006) included a finding that is often cited and may be somewhat controversial. The finding showed that there was significant overlap in the 95% confidence intervals between the student and professional sub-populations, therefore leading to the conclusion that "students may be used as surrogates for professional users" (King and He 2006). Strangely, this study also concluded that "...professionals and general users produce quite different results. However, students, who are often used as convenience sample respondents in TAM studies, are not exactly like either of the other two groups" (King and He 2006). Therefore the role that convenience samples versus non-convenience samples plays is ISC theory warrants examination.

Previous meta-analyses that have segmented the population by type of user typically categorized users as students vs. non-students (and sometimes further segmenting the non-student category into sub-groups such as Professionals and General Users) (Islam and Mantymaki 2011; King and He 2006; Schepers and Wetzels 2007). However, this segmentation does not specifically address the issue of convenience sampling. Therefore, this meta-analysis more succinctly categorized studies as either those which used convenience samples versus those that did not (i.e., non-convenience samples). Those studies that used students as surrogates for actual users were deemed to be in the convenience sample category. However, educational/e-Learning studies that used students as participants were not deemed to be part of the convenience sample category, as student participants in these educational contexts were actual users of the IS, and therefore not a convenience sample. A total of 17 studies were identified as using convenience sample participants.

Previous meta-analyses have shown larger effect sizes for student samples (Islam and Mantymaki 2011; Schepers and Wetzels 2007) and therefore it was hypothesized that the convenience sample participants (who are often students) would exhibit stronger effect sizes for the relationships of CONF-SAT, CONF-PU and CONF-CI. For both CONF-SAT and CONF-CI, the hypothesis was not supported, as the effects sizes for convenience samples were significantly lower than for non-convenience samples, as shown in Table 4. The hypothesis was supported only for CONF-PU, where convenience samples exhibited a significantly larger effect size than non-convenience samples, as shown in Table 4.

The results of this meta-analysis were somewhat different when compared to the earlier results reported by Islam and Mantymaki (2011) and Schepers and Wetzels (2007), in that this study found a majority of relationships had larger effect sizes for non-convenience samples, indicating that ISC studies using convenience samples may underestimate the strength of the CONF-SAT and CONF-CI relationships.

What is interesting to note is that these results question the conclusion of King and He (2006) that students may be used as surrogates for professionals. Given the results, it is not possible to definitively derive conclusions regarding the use of convenience samples versus non-convenience samples in ISC studies. However, researchers using ISC theory should take caution when considering the use of convenience samples, and may wish to seek actual user, non-convenience samples for their studies. The 95% confidence intervals support this statement, given that there is very little overlap between the sub-populations for both CONF-SAT and CONF-PU, as shown below in Figure 3, indicating that these sub-groups are very different and may not be considered as surrogates for one another.

As with the overall meta-analytic data, a credibility interval analysis was also completed on the sub-groupings of convenience samples and non-convenience samples. This analysis revealed that there are still potentially further moderators in operation (as the credibility intervals are still significantly large), but that the convenience samples group is more homogeneous than the non-convenience samples group. This conclusion is supported by Schepers and Wetzels who stated that "Students are a more homogeneous group than non-students" (Schepers and Wetzels 2007), given that convenience samples are often comprised of students.

Table 4. Comparison of effects for non-convenience samples (NCS) vs. convenience samples (CS)						
	CONF-SAT		CONF-PU		CONF-CI	
	NCS	CS	NCS	CS	NCS	CS
Number of studies	53	17	40	12	45	14
Sample size	23,272	3,693	19,939	2,504	21,567	3,203
Average sample size	439.1	217.2	498.5	208.7	479.3	228.8
Effect size	0.642*	0.607*	0.581*	0.626*	0.601*	0.584*
SD_p	0.249	0.158	0.209	0.092	0.219	0.178
95% Credibility interval	±0.488	±0.310	±0.410	±0.180	±0.429	±0.367
95% Credibility lower bound	0.154	0.297	0.171	0.446	0.172	0.217
95% Credibility upper bound	1.00[a]	0.917	0.991	0.806	1.00[a]	0.951
95% Confidence interval	±0.014	±0.036	±0.015	±0.044	±0.015	±0.039
95% Confidence lower bound	0.628	0.571	0.566	0.582	0.586	0.545
95% Confidence upper bound	0.656	0.643	0.596	0.670	0.616	0.623

* difference between NCS and CS is significant at the 0.001 level
SD_p = corrected standard deviation in effect sizes
[a] upper bound of the credibility interval was maximized at 1.00
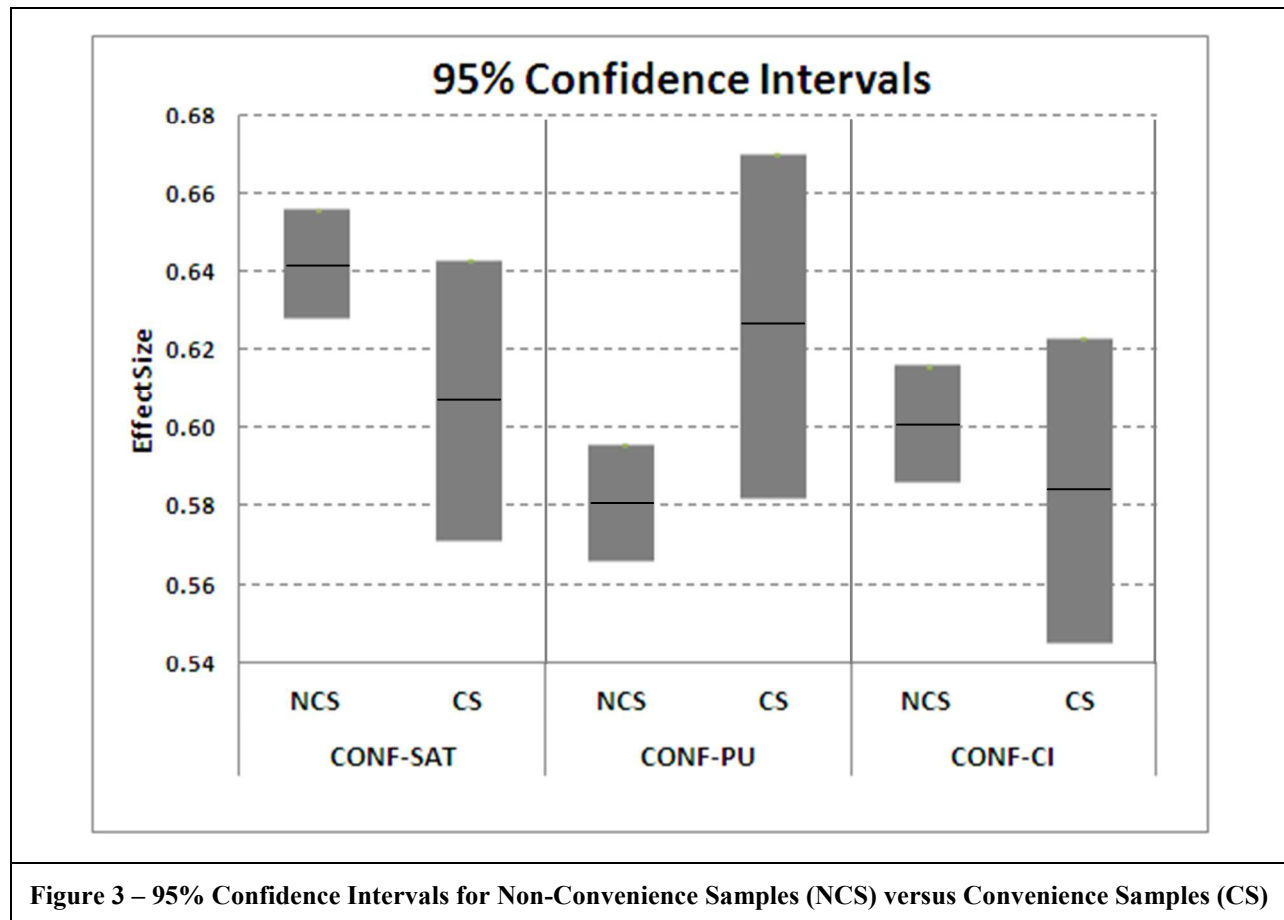
Human Behavior in IT Adoption and Use

Figure 3 – 95% Confidence Intervals for Non-Convenience Samples (NCS) versus Convenience Samples (CS)

Type of Technology

A limited number of studies examining the moderating effects of type of technology were found during an extensive literature search. Both the TAM meta-analyses (King and He 2006; Schepers and Wetzels 2007) developed a moderation analysis for technology type, segmenting the types as 1) office applications, task applications and job-office applications; and, 2) job-office applications, general and e-commerce/internet (King and He 2006) and microcomputer versus non-microcomputer (Schepers and Wetzels 2007) as the distinct types of technology. Given the substantial differences in the way these studies segmented the types of technology versus the way this meta-analysis has completed the segmentation (this meta-analysis segments by corporate, personal and educational), it is not possible to use the results of these previous studies in the development of hypotheses. In addition, the lack of theoretical support would make the development of hypotheses for this moderator analysis unsubstantiated. Therefore, this moderator analysis will be considered exploratory.

An assessment of the 75 studies gathered for this meta-analysis was made, looking at each study to determine if the context of the IS was Personal, Corporate or Educational (as outlined earlier). Based on this assessment, 38 studies (i.e., 50.7%) were categorized as Personal, 20 (i.e., 26.6%) were categorized as Corporate and 17 (i.e., 22.7%) were categorized as Educational (the education field appears to have vigorously adopted ISC theory to study e-Learning). To test the moderation effects, the data was split into sub-samples based on the above categorizations. The results of this analysis are detailed below in Table 5, and show that the effect sizes for the relationships between CONF-SAT, CONF-PU and CONF-CI are all significantly larger in an educational context, followed by the personal context and lastly the corporate context. We can therefore conclude that ISC theory may have the most applicability in an educational context, with stronger relationships between the constructs as compared to either personal or corporate contexts, followed by personal IS which showed stronger relationships as compared to a corporate IS context.

Logically this makes sense, as both Personal and Educational IS use is most likely voluntary and therefore confirmed expectations would be expected to have a strong relationship with satisfaction, perceived usefulness and intention to continue using the system. However, Corporate IS use is often mandatory, and therefore other factors such as co-worker pressure (i.e., Social Influence) would play a role, especially for intention to continue using the system (as the worker may not have a choice not to). This is supported by the fact that the relationship between CONF-CI in the Corporate IS context is the only one where the effect size can be considered medium (i.e., $0.10<r<0.50$) instead of large (i.e., $r>0.50$). Finally, an examination of the 95% confidence intervals reveals that for the most part, there is very little if any overlap between these sub-populations, as shown in Figure 4. This indicates that the strength of the relationships are inconsistent between these different sub-populations, again with Educational IS exhibiting significantly stronger relationships between CONF and SAT, PU and CI than the other two sub-groups.

As a next step in the moderator analysis, an examination of the credibility intervals was made to determine if there are further potential moderator effects. In all but one situation, the credibility intervals for Personal and Education IS are smaller than the credibility interval for Corporate IS. This would suggest that the Personal and Educational IS sub-populations are more homogeneous than the Corporate IS sub-group, and that there are most likely still further moderator effects in the Corporate IS sub-population. However, given that there are still somewhat large credibility intervals for both Personal and Educational IS sub-populations, there are likely further moderator effects in those sub-groups as well.

Table 5 - Comparison of type of IS effects for Personal (P) vs. Corporate (C) vs. Educational (E)									
	CONF-SAT			CONF-PU			CONF-CI		
	P	**C**	**E**	**P**	**C**	**E**	**P**	**C**	**E**
Number of studies	36	20	17	27	13	15	33	13	16
Sample size	18,465	4,929	4,051	16,162	3,183	3,578	17,935	3,554	3,761
Average sample size	512.9	246.5	238.3	598.6	244.8	238.5	543.5	273.4	235.1
Effect size	0.618†	0.612†	0.748*	0.574*	0.540*	0.668*	0.590*	0.482*	0.721*
SD_p	0.161	0.260	0.303	0.120	0.312	0.109	0.173	0.318	0.127
95% Credibility interval	±0.316	±0.510	±0.594	±0.235	±0.612	±0.214	±0.339	±0.623	±0.249
95% Credibility lower bound	0.302	0.102	0.154	0.339	-0.072	0.454	0.251	-0.141	0.472
95% Credibility upper bound	0.934	1.00[a]	1.00[a]	0.809	1.00[a]	0.882	0.929	1.00[a]	0.970
95% Confidence interval	±.016	±.030	±.033	±.017	±.038	±.019	±.016	±.037	±.018
95% Confidence lower bound	0.602	0.582	0.715	0.557	0.502	0.649	0.574	0.445	.703
95% Confidence upper bound	0.634	.642	0.781	0.591	0.578	0.687	0.606	0.519	0.739

* differences between P, C and E are significant at the 0.001 level

† difference is not significant at the 0.05 level between P-C, but is significant at the 0.001 level for P-E as well as C-E

SD_p = corrected standard deviation in effect sizes

[a] upper bound of the credibility interval was maximized at 1.00

Figure 4 – 95% Confidence Intervals for Personal (P) vs. Corporate (C) vs. Educational (E) IS
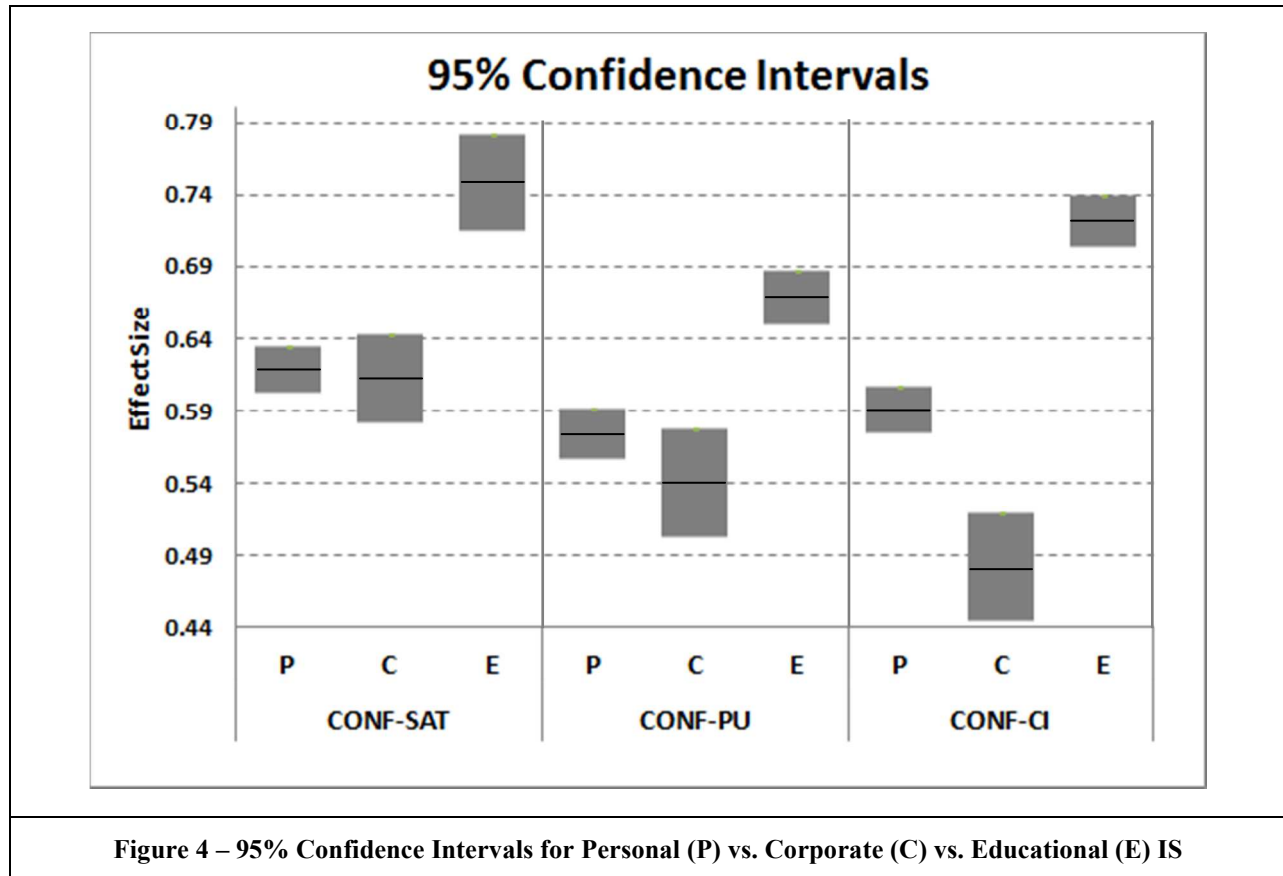
Discussion

For the past decade, IS researchers have utilized ISC theory and models in an attempt to explain the reasons why people continue to use an IS. This meta-analysis gives credence to those researchers and their research, as the results clearly indicate the large effect sizes when examining the relationships between CONF-SAT, CONF-PU and CONF-CI. This meta-analysis provides substantial support for ISC as a robust theory and model. At the outset of this meta-analysis, it was fully expected to see good effect sizes between the ISC variables. Intuitively, it makes sense that when people's expectations are confirmed, they will be more satisfied with the IS. This analysis clearly shows that the CONF-SAT relationship which for years has been utilized in studies based on EC theory and models is proven to be large (effect size of 0.639) in an IS setting under ISC theory and models. Secondly, the construct of CI also shows a strong positive relationship with CONF. Similar to SAT, this intuitively makes sense, as people whose expectations are met will be more likely to continue to use an IS. The effect size produced (i.e., 0.598) supports the importance of the CONF-CI relationship in ISC theory and models. Finally, the construct of PU (which was not included in the original EC theory and models) also showed a large effect size (i.e., 0.585) in its relationship with CONF in ISC theory and models. Unfortunately, an examination of the homogeneity of the results indicates that the effect sizes may not be estimating the same populations (i.e., Q-tests indicate heterogeneity and credibility intervals indicate the presence of moderators), and thus the results produced here should be utilized with some caution.

Additionally, analysis of potential moderators also showed heterogeneity within the groups, leading to the conclusion that perhaps there is a high amount of variability in ISC relationships, which should be considered by researchers. The first moderator analysis indicated that effect sizes are larger for non-convenience samples for the CONF-SAT and CONF-CI relationships, but larger for convenience samples for the CONF-PU relationship. One reason for this may be the fact that non-convenience samples (i.e., actual users) may have 'real-life' experience with the IS and therefore better understand the usefulness of the IS, whereas convenience sample participants who may have no or little 'real-life' experience with the

IS may tend to overestimate its usefulness. This is supported by a study by Venkatesh et al. (2003) cited by Islam and Mantymaki (2011) which found that "younger users [(arguably, convenience samples will contain younger persons)] placed more importance on PU" (Islam and Mantymaki 2011). The results of this moderator analysis indicate that researchers, and in particular those using ISC theory should strive to avoid convenience samples and attempt to secure the participation of actual users whenever possible. The second moderator analysis showed strong support for the use of ISC theory (where theoretically applicable) in educational IS contexts, and therefore it is recommended that researchers in this area continue and expand their use of ISC theory in their studies. In addition, the use of ISC theory is also recommended (where theoretically applicable) in both personal and corporate IS contexts, as the effect sizes for these sub-groups were also large.

Implications for Researchers and Practitioners

This study has valuable implications for both researchers and practitioners. For researchers, a base from which to report effect sizes for CONF-SAT, CONF-PU and CONF-CI has been established. Researchers can be confident in reporting the values developed in this meta-analysis, as they include a large number of highly relevant and reliable studies. Researchers can also use ISC theory with a great degree of confidence, with the knowledge that the influence of Confirmation on the other constructs has been proven to be strong based on over ten years of ISC study data. In general, these relationships between the ISC theory constructs remain strong regardless of the context, type of participant, or type of IS, and therefore researchers can confidently make use of ISC in a wide variety of situations.

The moderator analyses revealed a very important implication for researchers. Caution should be taken when using convenience samples in ISC studies, as the strength of the relationships may either be underestimated (for CONF-SAT and CONF-CI) or overestimated (for CONF-PU). This finding also calls into question the findings in other studies which suggest the use of students as surrogates for professionals (e.g., King and He 2006). It may be prudent to revisit the data from the King and He (2006) study and re-categorize the sub-groupings as convenience samples versus non-convenience samples. Another suggestion could be to complete a credibility interval analysis on the King and He (2006) student sub-group to ascertain the presence of further moderators. If there are, a further segmentation of this student sub-group could be completed to see if there are differences between MBA students (MBAs) and undergraduate students, and also whether MBAs may be used as surrogates for other types of users (e.g., professional, general).

For practitioners, it is very clear that in an IS context, developers need to ensure that they deliver on the promises that they make if they want to encourage continued usage of there is products and services. This meta-analysis shows very strong associations between users' expectations (of the IS) being confirmed and their satisfaction, perceived usefulness and intention to use. Therefore, if companies ensure expectations are met, they can feel confident that there is a greater likelihood of continued usage. The moderator analysis showed that this is especially crucial in an educational IS context, indicating that developers and implementers of these educational systems need to ensure that the expectations of their users are met. This will see increased importance in post-secondary education, as universities and colleges make greater use of IS in their teaching and curriculum support systems.

Meta-analysis Issues and Limitations

A number of issues and limitations can affect any meta-analysis, and therefore are addressed here, with a discussion of actions taken to mitigate their effects on this analysis. Sample sizes, with respect to both the number of studies used in the meta-analysis as well as the sample sizes of the studies included can be an issue. Typically, a small number of studies in the meta-analysis can have a negative impact on the statistical power of the meta-analysis (He & King, 2008). This was not a concern for this meta-analysis, as it contains 75 relevant studies. In addition, the average sample size of the studies utilized was 373.4 with a range of 41 to 4,670. To ensure that studies with large sample sizes did not alter the analysis, effect sizes were calculated with these studies included, and then excluded to ensure that the large sample sizes did not dramatically alter the analysis.

One criticism often made of meta-analyses is the "apples and oranges" issue, where studies utilized vary to such a degree that they cannot be compared and combined to produce an acceptable result. For this

meta-analysis, careful steps were taken to mitigate this issue. First, only studies that utilized the confirmation construct, and at a minimum one of the other three constructs were included. In fact, 46 of the 75 studies (i.e., 61.3%) included all four constructs, another 23 (i.e., 30.7%) used three of the constructs, leaving only 6 (i.e., 8.0%) studies that included only the two constructs. Secondly, all included studies were examined to ensure the constructs were defined and measured in a similar manner. Finally, only studies in the IS field were included in this meta-analysis. There are many studies which employ EC theory in other disciplines (e.g., marketing). However, to alleviate the comparison issues that could arise, only IS studies were included.

The issue of missing data that is required for the completion of the meta-analysis can be problematic. In this meta-analysis, three of the 75 studies did not report reliabilities. Therefore, the decision was made to perform a mean imputation, and utilize the mean of the other reliabilities as a proxy for the missing data. Given the large proportion of studies (i.e., 72 or 96%) that reported reliabilities (either Cronbach α or composite reliability), this imputation of means for the omitted reliabilities can be considered an acceptable method for dealing with the small amount of missing data.

Meta-analyses can only make use of data that is available to the authors. Therefore, typically only published studies are utilized, resulting in publication bias (often called the "file drawer" problem). This means that unpublished studies (such as theses that end up being filed) are not represented in meta-analyses. While every effort was made to access unpublished results, only three such studies were included in this analysis. Future revisions of this meta-analysis will make every effort to include additional unpublished studies and their potentially valuable information. Potential methods to circumvent the "file drawer" problem include a posting on the AISWorld mailing list to inquire about unpublished ISC study results that can be included in this meta-analysis.

Future Directions

A number of future directions, both immediate and long term are planned for this study. In the immediate future, an additional researcher will perform a second exhaustive literature search to ensure that no relevant studies have been missed. While the author is confident that all relevant studies have been discovered and included, it is prudent to have a 'second opinion', if only to reassure the reader that the most comprehensive search has been performed. Secondly, during the development of this paper, a select few studies (both unpublished and in some cases, published but missing correlation data) were identified as relevant to this meta-analysis. Authors of these studies have been contacted to gather the necessary details to allow these papers to be included in the meta-analysis, thus potentially increasing the number of studies.

In the longer term, there are plans to expand the meta-analysis of ISC, specifically looking at the other ISC relationships of PU-SAT, PU-CI, and SAT-CI. We will be able to utilize most of the papers gathered in this meta-analysis as a starting point, as many reported these relationships mentioned above. In addition, further moderation analyses will be completed, both examining the presence of new moderators (e.g., voluntary versus mandatory IS, etc.), as well as further segmenting the groups in the two moderator analyses presented here. For example, the non-convenience samples sub-group could be further segmented by professional user and general user, while the convenience samples sub-group could be further segmented by MBAs versus undergraduate students to see what differences exist, and potentially whether MBAs could be justified as surrogates for professional users.

Finally, most of the studies in this meta-analysis utilized Structural Equation Modeling (SEM) in their analysis and reporting of results. Therefore, a meta-analysis from an SEM perspective, utilizing either SEM-based meta-analysis or meta-analytic structural equation modeling (MASEM) methods will be conducted.

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(*) indicates papers used in the meta-analysis

Appendix 1

Authors	Study	Potential Issue	Actions Taken
Bhattacherjee, A.; Premkumar, G.	Understanding Changes in Belief and Attitude Toward Information Technology Usage: A Theoretical Model and Longitudinal Test	Longitudinal study with constructs reported at time 2 and time 3	Utilized time 2, as this was closest to the time of potential adoption and use
Chen, I.	The factors influencing members' continuance intentions in professional virtual communities - a longitudinal study	Two confirmation constructs (knowledge quality confirmation and system quality confirmation)	Utilized an average of the two constructs, as both are relevant to this meta-analysis
Chiu, C.; Hsu, M.; Sun, S.; Lin, T.; Sun, P.	Usability, quality, value and e-learning continuance decisions	Three confirmation constructs (usability disconfirmation, quality disconfirmation and value disconfirmation)	Utilized an average of the three constructs, as all are relevant to this meta-analysis
Chiu, C.; Wang, E., Shih, F.J; Fan, Y.W.	Understanding Knowledge Sharing in Virtual Communities: An Integration of Expectancy Disconfirmation and Justice Theories	Three confirmation constructs (knowledge quality disconfirmation, positive self-worth disconfirmation and positive social interaction disconfirmation)	Utilized knowledge quality disconfirmation only, as other disconfirmation constructs were not deemed to be theoretically relevant to this meta-analysis
de Vreede, G.-J.; Reinig, B.; Briggs, R.	e-Collaboration Satisfaction: Empirical Field Studies of Disconfirmation Theory Across Two Cultures	Two satisfaction constructs (satisfaction with process, satisfaction with outcome). Correlations not reported	Utilized an average of the two constructs, as both are relevant to this meta-analysis. Converted reported ANOVA F statistics to correlations.
Ha, H.-Y.	An integrative model of consumer satisfaction in the context of e-services	Repurchase construct utilized instead of CI.	Examined scale for Repurchase which revealed relevance due to its similarity to CI measure
Hayashi, A.; Chen, C.; Ryan, T.; Wu, J.	The Role of Social Presence and Moderating Role of Computer Self Efficacy in Predicting the Continuance Usage of e-Learning Systems	Reliabilities not reported for Confirmation, Satisfaction, PU or CI	Utilized average reliabilities reported from other studies included in this meta-analysis
He, W.; Wei, K.	What drives continued knowledge sharing? An investigation of knowledge-contribution and -seeking beliefs	Reliabilities not reported for Confirmation or CI	Utilized average reliabilities reported from other studies included in this meta-analysis
Hong, W; Thong, J.Y.L; Chasalow, L.C.; Dhillon, G.	User Acceptance of Agile Information Systems: A Model and Empirical Test	Two continuance intention constructs (Intention to continue using the agile IS, Intention to use future features)	Utilized an average of the two constructs, as both are relevant to this meta-analysis.

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Authors	Study	Potential Issue	Actions Taken
Jin, X.; Cheung, C.; Lee, M.; Chen, H.	How to keep members using the information in a computer-supported network	Two disconfirmation constructs (disconfirmation of information quality, disconfirmation of source credibility)	Utilized disconfirmation of information quality only, as the other disconfirmation construct was not deemed to be theoretically relevant to this meta-analysis
Liao, C.; Liu C-C.; Liu Y-P.; To, P-L.; Lin, H-N.	Applying the Expectancy Disconfirmation and Regret Theories to Online Consumer Behavior	Three disconfirmation constructs (Information quality disconfirmation, System quality disconfirmation and Service quality disconfirmation)	Utilized averages of the three constructs, as all are relevant to this meta-analysis
Liao, C.; Palvia, P.; Lin, H-N.	Stage antecedents of consumer online buying behavior	Two confirmation constructs (Confirmation of ordering process. Confirmation of fulfillment process)	Utilized averages of the two constructs, as all are relevant to this meta-analysis
Shi, N.; Li, M.K.O.; Cheung, C.M.K; Chen, H.	The Continuance of Online Social Networks: How to Keep People Using Facebook?	Four disconfirmation constructs (Disconfirmation of maintaining offline contacts, Disconfirmation of meeting new people, Disconfirmation of information seeking, Disconfirmation of entertainment)	Utilized averages of the four constructs, as all are relevant to this meta-analysis
Venkatesh,V; Thong, J.Y.L; Chan, F.K.Y; Hu, J.P-H; Brown, S.A.	Extending the two-stage information systems continuance model: incorporating UTAUT predictors and the role of context	Five disconfirmation constructs (Disconfirmation of effort expectancy, Disconfirmation of social influence, Disconfirmation of facilitating conditions, Disconfirmation of perceived usefulness, Disconfirmation of trust)	Utilized averages of the five constructs, as all are relevant to this meta-analysis
Wu, J.; Tsai, R.; Chen, C.; Wu, Y.	An Integrative Model to Predict the Continuance Use of Electronic Learning Systems: Hints for Teaching	Reliabilities not reported for Confirmation, Satisfaction, PU or CI.	Utilized average reliabilities reported from other studies included in this meta-analysis
Yen, C.-H.; Lu, H.-P.	Factors influencing online auction repurchase intention	Two disconfirmation constructs (disconfirmation of auctioneer, disconfirmation of seller) and two satisfaction constructs (satisfaction with auctioneer, satisfaction with seller)	Utilized averages of the constructs, as all are relevant to this meta-analysis