An Analysis of Three SERVQUAL Variations in Measuring Information System Service Quality

James J. Jiang[1], Gary Klein[2], Neeraj Parolia[3] and Yuzhu Li[4]
[1]The Australian National University, Canberra, ACT, Australia
[2]University of Colorado, Colorado Springs, CO, USA
[3]Towson University, MD USA
[4]University of Massachusetts at Dartmouth, MA USA
jjiangmis@gmail.com
gklein@uccs.edu
nparolia@towson.edu
yuzhu.li@umassd.edu

Abstract: Service provided by the information system (IS) department within an organization has come to be considered a major component of IS success. The determination of service quality is considered as a comparison process between an expected level of service and the service perceived by the user. In past research, an IS adaptation of the SERVQUAL measure from the marketing literature was commonly used since it considers both the expectation and performance components of service quality. IS researchers have applied the IS SERVQUAL metric in various forms, including as a difference score, as a single component only, and as two distinct components. The choice of an IS SERVQUAL variation was usually made based on psychometric properties of the scale or explained variance. Few considered the implications that the chosen form of IS SERVQUAL variation has on the relationship between service quality and a dependent variable such as satisfaction or on the theoretical interpretation of the discrepancy theories from which service quality measure is derived. We examined the implications to research models and theory due to choosing the form based on statistical properties. The two component form holds truest to theory and still retains valued statistical properties that are important to researchers. The one component form that includes on performance considerations is still superior to the difference score model. For purposes of prediction more useful for practitioners, the single component and two component model greatly outperform the predictive ability of the difference score model, with the two component model being slightly better than the single component model.

Keywords: information systems, service quality, SERVQUAL, service performance, service expectations, difference scores, user satisfaction, quality evaluations

1. Introduction

Service to the information system (IS) client is an essential aspect of the IS function (Kettinger and Lee, 1997). Practitioners evaluate service quality to assist in meeting client needs and tailoring a strategy to promote client relationships (Hoffman and Bateson, 2005). IS researchers incorporate service quality into models as an independent, intermediate, or even dependent variable to study a variety of research questions (April and Pather, 2008; Kettinger, Park and Smith, 2009; Roses, Hoppen and Henrique, 2009). Measuring the quality of service has become a crucial issue for IS researchers and practitioners (Carr, 2002; Petter, DeLone, and McLean, 2008).. SERVQUAL is a multidimensional measure that is widely applied in multiple business contexts by a large number of studies (Kettinger and Lee, 2005; Parasuraman, Zeithaml and Berry, 1988; Hoffman and Bateson, 2005). Studies in IS altered the SERVQUAL measure to the specific context under study, either through modification of the items, deletion of dimensions, or addition of dimensions (Carr, 2007; Kettinger and Lee, 1994; Wu, Lin, Cheng, 2009).

SERVQUAL was first designed to measure service quality at the expectation and perceived performance points, with service quality determined as the difference score between the two (Parasuraman, Zeithaml and Berry, 1988). Although the interpretive power of such a comparison is of high diagnostic value for practice, the difference score structure of perceived performance less expectations has been criticized heavily due to issues in using measures of difference scores in research(Watson, Pitt and Kavan, 1998). Because of known psychometric problems, a great deal of work has been expended on determining whether the IS SERVQUAL scale retains sufficient data quality properties to use in research models (Teas, 1994; Van Dyke, Kappelman and Prybutok, 1997). A good deal of research indicates that the difference scores are of sufficient quality to use in modeling (Carr, 2002; Jiang, Klein and Carr, 2002). Many researchers bypass the issue by employing only the perceived service performance component of the two component IS SERVQUAL measure (Cronin

and Taylor, 1994; Ma, Pearson and Tadisina, 2005). Recently, claims are made that treating the components as separate measures in a model may be the best approach to retain the information of both expectation and perceived performance yet avoid difference score issues (Klein, Jiang and Cheney, 2009).

In addition to the issues of data quality, considerations are required towards the implications to the research model and theory when IS SERVQUAL is applied in one of the three forms to represent service quality (difference between perceived performance of service and expected service, perceived service performance only, both expectations and perceived performance of service). Each form may vary in data quality. Each form generates a different statement about theory. Each form implies a different function and shape about the relationship to another variable. Predictive ability differs across the forms. We examine IS SERVQUAL as a metric not solely along the lines of data quality, but considering the implications of different forms on the underlying research model and theoretical interpretation. The contribution is to show the consequences of selecting the wrong form in a service quality research model employing SERVQUAL and to guide future research involving IS service quality models.

2. Background

Service is an important characteristic in the satisfaction of a client across just about every field, including information systems (DeLone and McLean, 2003; Hoffman and Bateson, 2005). Services are distinguished from products, such as software, in that they relate to performance and process rather than more concrete traits that can be tested, counted, and measured. Consumption and creation of services are inseparable, making the client an active participant in delivery and quality control difficult. Service can vary even under constant product conditions, as service personnel and perspectives change. The volatility and less tangible features of service make it difficult to establish ways to measure quality levels, especially given that quality of service is based on the expectations and perceptions of the service consumer.

In general, service quality is deemed to involve a comparison of expectations with performance. This conceptualization goes back a number of years and is well summarized by Lewis and Booms (1983):

> *Service quality is a measure of how well the service level delivered matches customer expectations. Delivering quality service means conforming to customer expectations on a consistent basis.*

A fundamental model that is still used as a basis of research determines service quality as the gap between expected service and perceived service performance (Parasuraman, Zeithaml and Berry, 1985). This attainment of expectations closely matches other psychological need fulfilment models that examine how attitudes are affected by the congruence between desires and the supplies in the environment that are available to meet those desires (Oliver, 1981). Expected service is based on personal needs of the customer as well as personal and second-hand knowledge about the service provider. Perceived service is based on communications between the provider and client as well as actual service delivery. A number of service quality determinants go into the formation of perceived service performance and client expectations. These determinants include access, communication, competence, courtesy, reliability, responsiveness, assurance, empathy, and certain tangibles (Parasuraman, Zeithaml and Berry, 1985). The SERVQUAL measurement scale was developed around five of these determinants to measure service expectations and perceived performance on the same items and dimensions so that a direct comparison between the two could be made (Parasuraman, Zeithaml and Berry, 1988).

The IS community has long recognized the importance of service (Kettinger and Lee, 1994). Researchers have modified the SERVQUAL instrument to the IS field and studied the psychometric properties extensively (Jiang, Klein and Carr, 2002). The more common IS SERVQUAL instrument is reduced to the determinants of reliability, responsiveness, assurance, and empathy. This has served as the basis of many studies in IS, with a limited sample shown in Table 1. Petter, DeLone and McLean (2008), summarize the history of service quality and SERVQUAL in the IS field:

> *Researchers have also suggested that service quality be added to the D&M model. An instrument from the marketing literature, SERVQUAL, has become salient within the IS success literature within the past decade. SERVQUAL measures the service quality of IT departments, as opposed to individual IT applications, by measuring and*

> *comparing user expectations and their perceptions of the IT department. Pitt, Watson and Kavan (1995) evaluated the instrument from an IS perspective and suggested that the construct of service quality be added to the D&M model. Some researchers have resisted this change (Seddon, 1997), while others have endorsed it (Jiang, Klein and Carr, 2002). DeLone and McLean (2003), after reviewing and evaluating this debate, decided to add service quality in their updated IS success model stating that 'the changes in the role of IS over the last decade argue for a separate variable – the service quality dimension.*

However, the use of the IS SERVQUAL instrument has come under fire due to its nature of computing the comparative process as a difference score (Van Dyke, Kappelman and Prybutok, 1997). To avoid using difference scores, many researchers use only the perceived performance portion of the instrument. Table 1 also highlights as to whether the full instrument was used in the particular study or only the perception of service performance component. Either approach has implications to modelling.

Table 1: Sample of SERVQUAL Applications in Information Technology

SERVQUAL application	Measure	Empirical Findings	Source
Service quality measured by SERVQUAL is in a model examining satisfaction and service reuse	Perception of service performance	Service quality is crucial in achieving value, satisfaction, and service reuse	Kettinger, Park and Smith (2009)
Components of SERVQUAL measure online service quality in a model of online auction pricing	Perception of service performance	Online service quality relates to auction price and perceived value,	Wu, Lin and Cheng (2009)
SERVQUAL is combined with usability measures to model usability of web based information systems	Perception of service performance	The service quality dimensions of SERVQUAL are an important aspect of usability for web based information systems	Oztekin, Nikov, Zaim (2009)
SERVQUAL is tested as a measure of service quality of online systems to complement teaching quality	Perception of service performance less expectation of service (difference score)	All SERVQUAL dimensions determine satisfaction of online learning systems along with teacher quality	Sohn, Park and Chang (2009)
The individual components of SERVQUAL are analyzed for differences between IT service providers and clients	Perception of service performance	Differences between providers and clients of IT service can identify strategic initiatives for improvement	Roses, Hoppen and Enrique (2009)
SERVQUAL is tested as a component in C2C satisfaction	Perception of service performance	SERVQUAL impacts overall satisfaction in C2C e-commerce along with TAM and TCA	Jones and Leonard (2007)
Measured portal service quality (as an independent variable)	Perception of service performance less expectation of service (difference score)	In addition to the four-dimension difference score SERVQUAL, other dimensions were suggested - only the SERVQUAL empathy dimension had a significant impact	Kuo, Lu, Huang and Wu (2005)
Developed and applied a modified SERVQUAL model for online shopping (as an independent variable)	Perception of service performance	Eight dimensions were found in a perception only measure and they were significantly related to satisfaction	Lee and Lin (2005)
Measured service quality for application service providers (as a dependent variable)	Perception of service performance	In addition to a four-dimension perception-only SERVQUAL (reliability, empathy, responsiveness, assurance), other dimensions were recommended (e.g., flexibility, security, availability).	Ma, Pearson and Tadisina (2005)

SERVQUAL application	Measure	Empirical Findings	Source
Measured IS Service Quality for IS sources (as a dependent variable)	Perception of service performance less expectation of service (difference score)	Gap score SERVQUAL was used to measure IS service quality as a consequence of IS sourcing type and was able to distinguish levels of service by source	Park and Kim (2005)
Measured the service quality of web sites	Perception of service performance less expectation of service (difference score)	Concluded that a gap score SERVQUAL was applicable to web sites	Iwaarden, Wiele, Ball and Millen (2004)
Measured retail service quality on the Internet	Perception of service performance less expectation of service (difference score)	Added a new dimension for the geographic distance and facelessness of the experience – gap measures on interpersonal interactions were less relevant than the technical variables	Long and McMellon (2004)
Measured the quality of internal IS service providers from the perspectives of both users and IS personnel	Perception of service performance less expectation of service (difference score)	Gap measures of SERVQUAL differ between the two populations	Jiang, Klein, Tesch and Chen (2003)
Measured the service quality of virtual community websites with a modified SERVQUAL	Perception of service performance less expectation of service (difference score)	Gap measure found that perceptions fall below expectations	Kuo (2003)
Measured the service quality of web-based customer support systems (as an independent variable)	Perception of service performance less expectation of service (difference score)	Information and system quality determined user satisfaction while the gap score SERVQUAL had no impact	Negash, Ryan and Igbaria (2003)
Measured EC channel service quality (as an independent variable)	Perception of service performance	Only one of the four-dimension perception-only SERVQUAL dimensions had a marginal impact on consumer satisfaction (i.e., assurance).	Devaraj, Fan and Kohli (2002)
Measured and examined IS service quality from the viewpoint of the IS professional	Perception of service performance less expectation of service (difference score)	The gap score SERVQUAL measure has adequate reliability, convergent validity, and discriminant validity with the same structure for both IS professionals and users	Jiang, Klein and Carr (2002)
Measured service quality in telemarketing	Perception of service performance less expectation of service (difference score)	Gap score SERVQUAL indicated that the sample population has perceptual problems with their telemarketing service experiences	Kassim and Bojei (2002)
Measured web-based service quality	Perception of service performance	A perception-only SERVQUAL measure indicated a need to modify SERVQUAL for the context of the web-based service	Li, Tan and Xie (2002)

The literature in consumer satisfaction provides a general model for the investigation of how IS service quality can impact user satisfaction (Churchill and Surprenant, 1982). Figure 1 shows the potential relationships for the IS setting. Expectations of service and perceived service performance lead to service quality, which is considered to be a disconfirmation measure of the gap between expectations and perceived performance. Expectations can also influence perceived performance as perceptions can be clouded by prior expectations (Niedrich, Kiryanova and Black, 2005). However, expectations are also often adjusted as service delivery is experienced (Parasuraman, Zeithaml and Berry, 1985), making it difficult to disentangle the three variables.

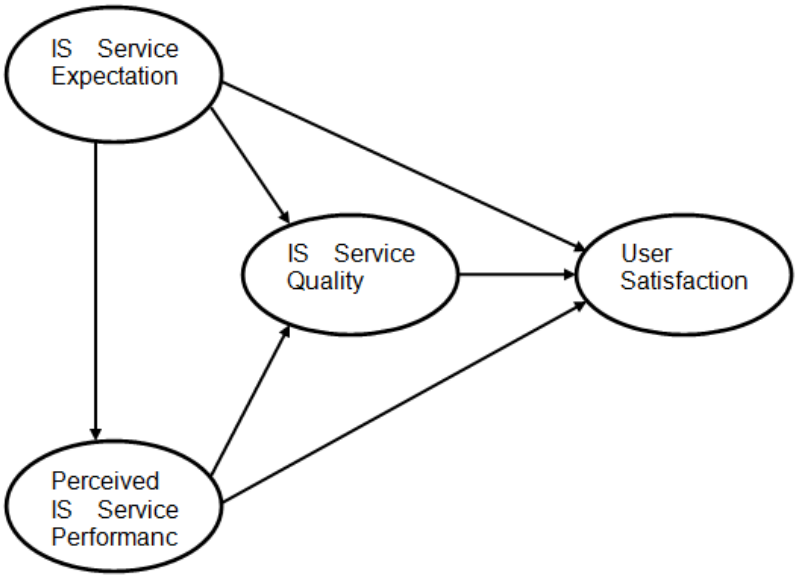


Figure 1. The determination of user satisfaction

All three variables potentially lead to user satisfaction. Past research finds support for various links in this structure with the more consistent support being for the links from either the service quality gap or from perceived service performance to satisfaction (Churchill and Surprenant, 1982). Although the IS SERVQUAL instrument and an appropriate measure of satisfaction allow a variety of links to be examined, the model cannot be analyzed in its entirety since the SERVQUAL measure of service quality is a difference of performance and expectation components measured separately.

3. Model Variations

Measurement of service quality in research models has taken three basic forms derived from the possible linkages in figure 1. The first model considers only the discrepancy variable to represent service quality in relation to a dependent variable. A second limits the study to only the perception of service performance component to represent service quality. A third considers both components, perception of service performance and expectation of service, in the relationship to the dependent variable. We consider IS user satisfaction as the dependent variable and the SERVQUAL component measures to represent the independent. We examine the use of each model from a conceptual view followed by an empirical analysis using a recent IS SERVQUAL data collection.

3.1 Service Quality to Satisfaction

The link from service quality to satisfaction is considered a disconfirmation relationship (Churchill & Surprenant, 1982). As can be seen in Table 1, many studies employ this as the complete model in determining eventual satisfaction. In the IS case, the user perceives a gap in one direction or another. In the case of service quality, a gap where perception of service performance exceeds service expectations is a positive situation, while a failure to meet expectations is treated with disdain by the client (Parasuraman, Zeithaml and Berry, 1988). SERVQUAL considers this situation by taking the difference of perceived service performance (P) and expected service (E) to acquire a difference score for service quality (Q = P – E). From there, any dependent variable (user information satisfaction in this case) is determined as a function of service quality (UIS = f(Q)). Concerns are immediate for the quality of the measure since difference scores are known to suffer from low reliability, unstable dimensionality, and poor discriminant validity (Van Dyke, Kappelman and Prybutok,1999). However, numerous studies find the difference scores determined by SERVQUAL to have sound data quality properties, certainly to the point where each data set can be independently validated rather than lumped in the general category of worthless data (Jiang, Klein and Carr, 2002).

Still, there are further issues that must be considered by the researcher when employing the disconfirmation concept, especially using a difference score. First, a difference score implies that the weights on the perceived perception and expectation are equal magnitude but opposite sign. This can be seen by taking the relationship from a regression:

$$UIS = \alpha + \beta(Q) + \varepsilon \qquad (1)$$

and substituting the component scores to get

$$UIS = \alpha + \beta(P - E) + \varepsilon, \quad (2)$$

or

$$UIS = \alpha + \beta P - \beta E + \varepsilon. \quad (3)$$

This restriction provides a set shape to the relationship and restricts the importance of each component unnecessarily. Difference scores also imply that magnitude of the individual components does not matter, that a gap at a high level of performance generates the same level of satisfaction that a same size gap does at a horrible level of performance (Klein, Jiang and Cheney, 2009). Perhaps more importantly, the discrepancy theories that serve as a basis for the relationship have no requirement that the component weights have equal magnitude but opposite weights. As such, the choice of a difference score modifies the theory via the implicit assumption, likely not an intention of the researcher. Should difference scores be employed, the assumptions should be tested to ensure the data is representative (Klein, Jiang and Cheney, 2009).

To avoid the issue of the implicit assumptions, researchers recommend the use of a direct measure for service quality by asking subjects to state the magnitude and direction of the gap (Niedrich, Kiryanova and Black, 2005). This bypasses statistical issues associated with difference scores and allows clients to adjust their internal assessment of expectations after the service is experienced. A question that directly seeks this gap is suggested in the literature to be similar in nature to "the instructor was as prepared for class as I had predicted" (Niedrich, Kiryanova and Black, 2005). Edwards (2001) indicates that such an approach merely shifts the onus of creating a difference score from the researcher to the subject. The resulting scores are prone to the same potential problems that plague difference scores because these problems do not depend on whether the respondent or the researcher calculates the difference. Moreover, an item that elicits a direct comparison is double-barrelled, given that it combines two distinct concepts into a single score (DeVellis, 1991).

3.2 Perceived Service Performance to Satisfaction

A further concern of difference scores is the impact in terms of predictive power or significance of the relationship. Studies into the predictive power of the SERVQUAL difference score compared to the perceived service performance only variant (SERVPERF) cross many contexts (Boulding, Kalra, Staelin and Zeithaml, 1993; Cronin and Taylor, 1992; Van Dyke, Kappelman and Prybutok, 1997). These studies found out that the performance only measure has stronger data quality characteristics, in terms of validity and reliability, and also better predictive value. Other studies find that the difference score model is just as valid and has no less value as a predictor (Kettinger and Lee, 1997; Pitt, Watson and Kavan, 1997). If prediction is the goal of the model, then it may be wisest to let the data determine the best fit (Hanke and Wichern, 2008).

On the other hand, the performance-only model renders expectations inconsequential to the outcomes by forcing the coefficient on service expectations to zero. This suggests that there may be a recency effect that causes the performance evaluations to be most salient and influential (Tversky and Kahneman, 1974). Many researchers, including those in IS, have adopted this performance-alone model, due to the difficulty involved in the disconfirmation model. However, if the model investigated is based on any of the discrepancy theories, or relies on accepted definitions of service quality, then the use of the perceived service performance only variant of SERVQUAL is an improper measure without explicit testing of the zero coefficient assumption.

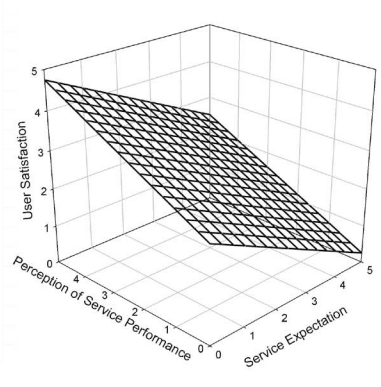
3.3 Perceived Service Performance and Service Expectations to Satisfaction

Another potential variation is to employ both components of the IS SERVQUAL instrument in the development and testing of the model. In this case, just the relationships between perceived service performance and service expectations to user satisfaction remain. The advantages to this model over both the difference score approach and the performance only approach are evident from the equation that now represents the formation of user satisfaction:

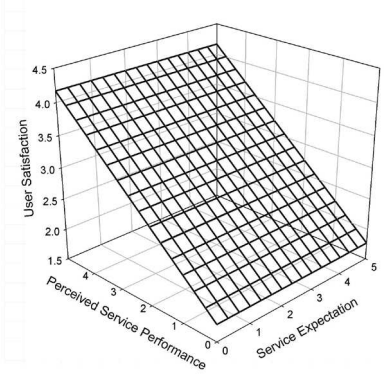
$$UIS = \alpha + \beta P + \gamma E + \varepsilon \qquad (4).$$

Both prior models can be represented with this variant, by having β = -γ for the difference score approach and γ = 0 for the performance only approach. Models that contain more complexity than a simple regression, such as structural equation models, can employ both components in the model or use block variables to represent the desired structure (Cheung, 2009; Marsden, 1982). In this case, IS SERVQUAL is still applicable since both components are measured separately.

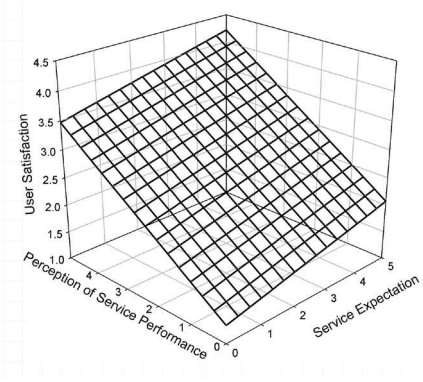
Figure 2 shows three shapes represented by the IS SERVQUAL dimensions and user satisfaction under the three models presented. The first shows a difference score relationship, where the curve is flat on any line where P – E is a constant. Here, there can be no situation where the magnitude of either component makes a difference to final satisfaction, only the difference between components. The second graph shows a performance only relationship, where the weight on satisfaction is zero, a reduction from 3 to 2 dimensions. The third graph shows a possible result considering both components in the relationship to user satisfaction. Here the discrepancy between components is still present and significant as can be seen by the increase to satisfaction above the P = E line and the decrease to satisfaction below the P = E line. Yet it also allows magnitude to play a role as satisfaction is higher for higher levels of perceived service performance. A hint of the perception only model is also present as the slope of the curve along the P axis is steeper than for the E axis.



2a. Difference score shape



2b. Performance only shape



2c. Both Components shape

Figure 2. Shape implications of the three model variants

4. Research Methods

In order to examine specific issues for each model with the IS SERVQUAL scale we performed a data collection with IS users. The data help determine the validity of assumptions made by the different models, whether IS SERVQUAL retains high validity and reliability properties, and the predictive power of the different models using SERVQUAL as the scale.

4.1 Data Collection

An IS SERVQUAL and User Satisfaction (UIS) questionnaire were mailed to 412 managers in different organizations in the United States who were not managers in an information technology department. The list of managers for contact included one manager from all organizations maintained by an economic development center at a Midwestern university. The managers were requested to

complete the instrument as users of information systems and having contact with members of the IS department within their organization. If the managers did not feel they qualified, they were requested to pass the instrument on to a member of their functional area who has frequent contact with the IS department. All the respondents were assured that their responses would be kept confidential. The managers were contacted up to three times by graduate assistants by phone to remind them to please respond to the questionnaire. A total of 308 questionnaires were returned with a response rate of 75%. The demographic information for these respondents is shown in Table 2.

Table 2: Demographics

Demographic Variable	Category	IS Users
Gender	Male	168
	Female	139
	No response	1
Age	25 & under	109
	> 25 & 35 <	110
	>= 35 & < 45	56
	>= 45	42
Work Experience	5 years & under	128
	> 5 & <= 10	75
	> 10 & <= 20	64
	> 20 Years	41
# of IS employee on local staff	< 10	95
	> 10 & <=25	80
	> 25 & <=50	92
	> 50	23
	No response	18
Position	Management	111
	Professional	197

4.2 Data Validity

The IS SERVQUAL instrument as identified for IS users was employed in this study (Kettinger and Lee, 1994). The tangibles dimension was not included as in other studies of IS service quality. Brief descriptions of the items included in the study are presented in Table 3. The instrument used to measure user satisfaction is from Baroudi and Orlikowski (1988). While the validity and reliability of the User Information Satisfaction (UIS) measure is widely recognized in the IS field, the measure was subjected to the same tests as the SERVQUAL scale. All t-tests for both measures are significant, showing that all indicators are effectively measuring the same construct, or have high convergent validity. Reliability was assessed as shown in Table 3 for SERVQUAL and table 4 for user satisfaction.

Table 3: Loading, Composite Reliability, and AVE of IS SERVQUAL

		User Expectation		**User Delivery Perception**		**Difference Score**	
	Brief Item Description	Loading	t-statistic	Loading	t-statistic	Loading	t-statistic
Reliability		0.87 (CR) 0.89 (α.) 0.58 (AVE)		0.93 (CR) 0.91 (α) 0.73 (AVE)		0.92 (CR) 0.89 (John's α) 0.68 (AVE)	
1	Done by time promised	0.84	37.46*	0.88	57.01*	0.87	45.93*
2	Sincere in solving user problems	0.88	58.28*	0.86	46.38*	0.84	43.47*
3	Dependable	0.84	35.75*	0.86	47.71*	0.84	35.99*
4	Services on schedule	0.89	52.63*	0.90	72.92*	0.86	53.12*
5	Insist on error-free records	0.72	18.72*	0.78	24.28*	0.71	21.71*
Responsiveness		0.89 (CR) 0.84(α) 0.67(AVE)		0.91(CR) 0.86(α) 0.71 (AVE)		0.87(CR) 0.82(John's α) 0.64 (AVE)	
6	Tell users exact times	0.79	26.82*	0.80	29.05*	0.76	29.67*
7	Prompt service	0.88	57.27*	0.88	54.40*	0.82	36.37*
8	Willing to help	0.86	37.61*	0.86	50.07*	0.83	51.30*

		User Expectation		User Delivery Perception		Difference Score	
9	Never too busy to respond	0.75	22.00*	0.83	42.44*	0.77	23.62*
Assurance		0.90 (CR) 0.85(α) 0.68(AVE)		0.91(CR) 0.87(α) 0.72 (AVE)		0.86(CR) 0.79(John's α) 0.60 (AVE)	
10	Behavior instills confidence	0.80	24.99*	0.88	65.04*	0.78	23.98*
11	Users safe in their transactions	0.84	38.84*	0.88	62.53*	0.82	32.24*
12	Consistently courteous	0.84	35.16*	0.80	32.10*	0.72	17.77*
13	Have necessary knowledge	0.82	31.56*	0.84	41.25*	0.78	31.99*
Empathy		0.91 (CR) 0.88(α) 0.68(AVE)		0.91 (CR) 0.87(α) 0.67 (AVE)		0.86 (CR) 0.80(John's α) 0.55 (AVE)	
14	User gets individual attention	0.84	42.17*	0.85	59.66*	0.73	17.61*
15	Convenient hours	0.76	27.78*	0.70	21.92*	0.66	11.69*
16	IS staff give personal attention	0.84	47.27*	0.84	47.48*	0.77	21.27*
17	Have best interest at heart	0.84	35.93*	0.87	53.82*	0.78	28.10*
18	Understand user needs	0.83	30.54*	0.82	33.75*	0.76	20.43*

**: p <0 .01*

Notes: CR: Composite Reliability, α : Cronbach's Alpha , AVE: Average Variance Extracted

Table 4: User Satisfaction - Convergent Validity, and Reliability

Items	Loading	T-value	CR	α	AVE
User Involvement			0.85	0.78	0.53
Processing of requests for changes to existing systems	0.74	23.74*			
Degree of IS training provided to users	0.71	22.69*			
User's understanding of systems	0.70	18.74*			
Users' feelings of participation	0.75	28.25*			
Time required for new system development	0.72	20.34*			
IS Staff Service			0.87	0.77	0.70
Relationship with IS professional	0.87	59.84*			
Attitude of the IS professional	0.76	26.93*			
Communication with IS professional	0.87	52.08*			
Information Product Quality			0.90	0.85	0.68
Reliability of output information	0.84	38.20*			
Relevance of output information	0.87	55.14*			
Precision of output information	0.76	34.11*			
Completeness of output information	0.83	34.38*			

*Notes: *: p <0 .01, CR: Composite Reliability, α: Cronbach's Alpha, AVE: Average Variance Extracted*

Structural Equation Modeling (SEM) with Partial Least Squares (PLS) analysis allows an empirical assessment of the constructs (Löhmoller, 1988). PLS-Graph Version 3.01 was used to verify the measures in this study (Chin, 1994). Individual item reliability is indicated by a high factor loading, implying that the shared variance between a construct and its measurement is higher than the error variance (Hulland, 1999). In Tables 3 and 4, the loading of all indicators are at or above 0.7, which indicates that all item measurements are acceptable, and significant (Hulland, 1999).

Convergent validity can be examined by the composite reliability of constructs (>= .70 is recommended) and item-construct correlation (>= .70 is recommended) (Fornell and Larcker, 1981). Table 3 presents these and other convergent validity measures for SERVQUAL. Table 4 shows the convergent validity and reliability of user satisfaction. The Cronbach alpha of each construct was above 0.7, which indicates high internal consistency (Nunnally, 1978). Reliability of difference scores were measured with John's alpha rather than Cronbach's alpha (Van Dyke, Kappelman, Prybutok 1997). Average variance extracted (AVE), proposed by Fornell & Larcker (1981), reflects variance of the construct that is captured by the indicators. Evidence regarding discriminant validity can be demonstrated if the square root of AVE is greater than the correlations of the constructs, as is the case in all instances, as can be seen in Table 5.

Table 5: Descriptive analysis of components

					Correlations		
Variables	Mean	Std	M3	M4	Exp	Perf	U.Sat.
Expectation	4.17	0.65	-1.47	3.97	**0.91**		
Performance	3.62	0.75	-0.54	0.22	0.42	**0.91**	
User Satisfaction	3.55	0.59	0.16	-0.22	0.43	0.68	**0.80**

M3: skewness; M4: kurtosis.

The diagonal line of correlation matrix (in bold) presents the square root of AVE.

In the literature, SERVQUAL is usually considered to be a 2nd-order construct. The *T* coefficient (χ2 values of first order/χ2 values of second order) suggested by Marsh and Hocevar (1985) was used to examine the efficiency of SERVQUAL measured as a 2nd-order. A target coefficient of .90 suggests that the second-order factor provides good explanation of the covariance among the first-order factors. In this study, each of the expectation (*T* = .96) and performance (*T* = *.94) T* coefficients exceeds the suggested *T* coefficient minimum. Furthermore, the coefficients from the 2nd-order construct to each 1st-order constructs are all significant and were all greater than .90. Thus, SERVQUAL is further examined as a 2nd-order construct in this study as suggested in the literature.

Common method variance is a potential problem when both dependent and independent variables are collected from the same respondent at the same time. In this study, Harman's single factor test was conducted to check whether variance in the data can be largely attributed to a single factor (Podsakoff, MacKenzie, Lee and Podsakoff, 2003). Items for both dependent and independent variables were entered in order to conduct an exploratory factor analysis. The analysis indicates that multiple factors were extracted and that items for dependent variables and independent variables fall into different factors. The results indicate that the data does not suffer from common method variance since multiple factors are evident in the data.

The Harman's single factor test is a less conservative test for common method factors. Controlling for the effects of an unmeasured latent method factor is another widely adopted and more conservative technique which also does not require the identification and measurement of the specific factor responsible for the method effects (Podsakoff, MacKenzie, Lee and Podsakoff, 2003). If a method factors exist, the methods model should explain significantly more variance in the data than the model without a method factor. Following the recommended procedure, the normed fit index (NFI) showed a change of only 0.02, which indicates insignificant improvement to the model (Bentler and Bonett, 1980). This result also indicated that the data does not likely suffer from common method variance.

Component scores are used in all of the analyses that follow. In addition, Cronbach (1987) argues that scale-centering reduces multicollinearity between component measures and their associated higher-order terms and facilitates the interpretation of coefficients on first-order terms when higher-order terms are in the equation. Therefore, measures for the components were adjusted by subtracting the scale midpoint - producing scores that could range from -3 to +3. The resulting variables were all tested against each demographic variable to determine any bias due to the sample characteristics with an ANOVA. No test was found significant.

4.3 Data Analysis

All three variations of the model are tested with simple regression. The results are shown in Table 6. Each curve would be similar to those drawn in Figure 2. The significant, positive coefficient on expectations in the separate components model indicates that a perception only view of SERVQUAL is faulty given that satisfaction influences UIS ($\neq 0$ in equation 4). Likewise, since both coefficients are significant and positive in the separate components model, the assumption of weights having opposite signs of equal magnitude does not hold, indicating the difference score model is also an invalid form for SERVQUAL to measure service quality in determining user satisfaction. In the comparison of R^2 values, the separate components model is statistically superior (at $p < .05$) to either of the other models. Thus, as a predictor, the separate components model is superior in this data set. Logically, this should hold as the removal of variables from a regression will only serve to lower R^2.

Table 6: Regression Coefficients and R^2 for the three model variants

	Separate Components			Perception only		Difference Score	
User Satisfaction	E	P	R^2	P	R^2	P-E	R^2
Service Quality	**0.15***	**0.43***	**0.44**	**0.48***	**0.41**	**0.23 ***	**0.10**

**significant at p < 0.05*

As a final point, some experts consider that SERVQUAL may contain nonlinear relationships to satisfaction. The zone of tolerance would indicate a relatively flat spot in user satisfaction for a length of perceived service performance with a sharper increase at the high end and decrease at the lower end (Kettinger and Lee, 2005; Mittal, Ross and Baldasare, 1998). Various discrepancy theories would require a convex or concave shape to the curve (Brown, Venkatesh, Kuruzovich and Massey, 2008; Edwards and Cooper, 1990; Jiang and Klein, 2009). Others feel that prospect theory or diminishing returns play a role in the shape of attitudinal relationships (Kahneman and Tversky, 1979; Edwards and Cooper, 1990; Johnston, 1995). Both for reasons of being good practice to examine assumptions of linearity and to consider the possibility of nonlinear theories holding, a simple examination with nonlinear regression can serve to address this issue (Klein, Jiang and Cheney, 2009). For this data, a polynomial regression with an interaction term, squared terms, and cubic terms found no higher order to have a significant coefficient, indicating a linear model appropriate for the relationship of both SERVQUAL components to user satisfaction.

5. Concluding Remarks

When considering models involving IS service quality, researchers rely on components of service expectation, perceptions of service performance, or a disconfirmation resulting from a comparison of the two. IS SERVQUAL measures both the expectations and perceived service as components. Disconfirmation is usually computed as the difference score between perceived service performance and expectation of performance. IS research models that consider service quality as a variable will typically use the difference score, the performance score, or the set of both components. Though a great deal of research has been done on the validity and reliability of the SERVQUAL scale, few have considered the applicability of the SERVQUAL metric to the model variants based on the underlying theories of service quality. The goal of this study was to explore the implications of three representation forms of service quality using IS SERVQUAL to the research model and underlying theory.

After IS users completed an instrument of IS SERVQUAL and User Satisfaction, three research models were considered. The first model is a disconfirmation as service quality related to user satisfaction, measured by the difference score of IS SERVQUAL expectation and perceived performance. This model is rooted in consumer theories that consider the comparison of these two prime determinants of service quality. However, an examination of the SERVQUAL data indicates a violation of two basic assumptions of difference scores, calling the use of the model or the scale into question. Further, the explained variance is very small, showing that the difference score of the IS SERVQUAL components may not be effective predictors.

The second model considers only the perceived performance component of IS SERVQUAL. Previous research has shown that the single measure often performs better in tests of validity and in achieving

higher R^2 values. Thus, it is considered to be a better predictor and representation of service quality. The data in this study does achieve a higher R^2, but does not exhibit any better data quality in terms of validity or reliability. In addition, the model eliminates the expectation dimension altogether, removing potentially valuable information from the equation and violating the underlying theory requiring a comparison. From a regression standpoint, the expectation component is forced to have a zero weight.

The third model includes both SERVQUAL components as separate variables in the relation to user satisfaction. In this case, the validity and reliability of the individual components are the determinants of data quality, which are high in this data set and reported high in most previous studies. The maintained separation allows the regression to determine the weights on the individual components instead of forcing weights as in the other two models. Disconfirmation is maintained since the shape of disconfirmation is not specified in consumer theories. The two component model allows more shapes and improves the explained variance over the perceived performance only model in this data set, and will not do worse in any data set. Therefore, researchers should use both the expectation and performance component in theoretical modeling. The performance only measure might be acceptable in research only if parsimony is needed in simple models of data collection. The two component model for prediction purposes is far superior to the difference score model, but only slightly better than the performance only model when judged by the R^2 values.

This paper contributes to the continuing debate over the value of IS SERVQUAL to measure service quality of the IS function within an organization. The analysis of the data set adds to the evidence that IS SERVQUAL has high validity and reliability. Completely novel, however, is the examination of the appropriateness of using IS SERVQUAL under three model variants. This is crucial as each model makes different statements about the underlying theory and assumptions that must be present in the data. Preliminary results indicate that it is best to utilize models that maintain the two components independently. Theory is best preserved with the two component model. Predictive ability is best for the two component model, but only to a small degree over the one component model that includes only performance. Complex models may require consideration of advanced path methods or variable blocking (Cheung, 2009; Marsden, 1982). Similar investigation into other variations of SERVQUAL should be conducted, such as the Zone of Tolerance model (Kettinger and Lee, 2005).

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