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34. The Impact of Analyst-User Cognitive Style Differences on User Satisfaction

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Abstract

This study explored the relationship between user satisfaction and cognitive style as applied to users and systems analysts over the time of system usage. Based on a sample of 62 'user-systems' this study found that the absolute differential in analyst-user cognitive style, or cognitive gap, generally impacts user satisfaction negatively throughout the period of system usage. However, this effect was found to be only particularly strong at two stages of system use; in the third and twenty-first months of system usage. It is thus suggested that analysts should be allocated to users with similar cognitive styles, as one means of optimizing user satisfaction during system usage. Also, that if this precaution is not taken, the system is most likely to stall during the third and twenty-first months of usage. This study thus has important implications for IS team choice during system usage, as well as for system development and maintenance. The results are discussed and conclusions are drawn.

Keywords: User satisfaction, Systems Satisfaction Schedule, S statistic, Cognitive style

Introduction

Current information systems (IS) literature suggests that user satisfaction is a significant ingredient of system success (DeLone and McLean 1992, 2003; Boudreau, et al., 2001; Cooper, 2000). Definitions of user satisfaction are open to question, where studies essay to give any kind of definition at all. Previous user satisfaction instruments include the Computer User Satisfaction instrument (Bailey and Pearson, 1983), its derivative, the User Information Satisfaction (UIS) instrument (Baroudi, Olson and Ives, 1983), Zhang and von Dran's (2000) Model of Website Design instrument, and Cheung and Lee's (2005) Users' Satisfaction with E-portals instrument. An important limitation of these instruments is their inability to yield reliable results when used repeatedly with the same respondent (Mullany, Tan and Gallupe, 2006). Mullany et al. (2006) developed another measuring technique which they claim can be used to measure user satisfaction repeatedly with the same user, making the production of time-wise profiles of user satisfaction possible.

Studies, such as that by Trauth and Cole (1992) suggest that computer systems and their interfaces should be designed to cater for the 'cognitive style' of the user. Cognitive style is associated with a person's mental organization of concepts and the way they use these in their approach to problem-solving. As users employ systems as problem-solving tools, one would expect to find a relationship between the cognitive styles of users and analysts, and user satisfaction. This empirical study consequently focused on user satisfaction as it changes with system usage, and how this is impacted by the cognitive style differences between users and analysts. Any such cognitive style difference is referred to in this paper as a *cognitive gap*. The present study contributes to IS theory by establishing the impact of analyst and user cognitive styles over the period of system usage. Consequently, it further yields recommendations for

the choice of systems analyst, given the cognitive style of the user. This study is differentiated from its predecessors by exploring two fundamental research questions:

1. Does the cognitive gap between analysts and users yield advance predictions of overall user satisfaction with a given system? and
2. Is there a changing pattern of relevancy of the effect of the cognitive gap over the period of system usage?

To answer these questions, a choice of instruments to measure user satisfaction and cognitive style was required. User satisfaction was measured using the System Satisfaction Schedule (SSS) of Mullany, Tan and Gallupe (2006) on the grounds that it can measure and document user satisfaction repeatedly, over time, with the same user. This yields a measure of user satisfaction, which they denoted S. Cognitive style was measured using the Kirton Adaption-innovation Inventory (KAI) (Kirton, 1976, 2003). This instrument was chosen over others on account of its ability to separate out cognitive style and cognitive level.

This paper begins with an outline of relevant prior work from the literature relating to user satisfaction and cognitive style. Research questions and hypotheses are developed next. The research method and results follow. The implications of the findings for system development, usage and maintenance are then discussed. Finally, a summary of the key conclusions is given.

Prior Research

The meaning and significance of user satisfaction in IS research and practice

According to a number of authors, the significance of user satisfaction revolves upon its link to *system success*. For example, DeLone and McLean (1992) suggest that user satisfaction is “probably the most widely used single measure of IS success”. However, they claim, several existing measures of user satisfaction and system success are highly unsatisfactory, being “either conceptually weak or empirically difficult to obtain”. Our examination of the literature suggests that the concept of user satisfaction has advanced in three stages; early factor-based, recent factor-based, and user-generated factor-based instruments.

In the case of early factor-based instruments such as the CUS, Bailey and Pearson (1983) produced a set of ‘factors’ which they considered contributed completely to user satisfaction. Ad hoc though this may seem, the CUS remains an important standard (DeLone and McLean, 1992, 2003), as does its derivative, the UIS (Baroudi et al., 1983). However, such instruments have two major limitations; they tend to highlight issues not relevant to the user while omitting those that are. This means that the respondent could add significant ratings of unimportant factors that are given on the instrument, while excluding the highly significant ratings of important factors, which are not. Additionally, there is little evidence of any psychological or sociological basis for these instruments.

Recent factor-based instruments tend to be aligned to psychological theories. For example, Zhang and von Dran’s (2000) ‘Website User Satisfaction instrument’, and Cheung and Lee’s (2005) ‘Measure of User Satisfaction with E-portals’, are aligned to Herzberg’s (1968) motivation-hygiene theory of job attitudes. According to Herzberg (1968), both job satisfaction and motivation are distinct from the factors that lead to job dissatisfaction. He calls the latter *hygiene factors*. Unsatisfied hygiene factors, he claims, cause demotivation. However, satiated hygiene factors do not motivate. Hygiene factors are associated with the work environment or context. Zhang and von Dran’s (2000), and Cheung and Lee’s (2005) instruments, though

based on Herzberg's theory, still retain the disadvantages of potentially exhibiting factors not important to the respondent while omitting factors, which are.

More recently, Mullany, Tan and Gallupe (2006) devised an instrument which utilizes user generated factors almost exclusively. Also aligning themselves to Herzberg, these authors argue that the perceived usefulness (or otherwise) of tools of the trade are contextually related, and so are special cases of hygiene factors. They consequently define user satisfaction as the absence of user dissatisfaction and complaint, as assessed by users who have had at least some experience of using the system (Mullany et al., 2006). In other words, *satisfaction* is based on *memories of the past* use of a system. *Motivation*, conversely, is based on *beliefs about the future* use of the system. Since beliefs about the future are based to an extent on memories of the past, satisfaction (or dissatisfaction) with past system usage will influence motivation to use the system in the future. Conversely, memories of poor past motivation when using a system will contribute to dissatisfaction with its use. Hence past motivation is one case of a hygiene factor. Thus the notion that satisfaction is based on memories of the past and motivation is based on beliefs about the future, while completely separating out the *concepts* of satisfaction and motivation, also suggests how they are inextricably linked (Mullany et al., 2006).

We consequently accepted their definition of user satisfaction as the absence of user dissatisfaction and complaint in this study. As it is difficult to see how a user with no experience of a system can rate it reliably, we also accept *a priori* that a user needs to have at least some experience of the system before they can satisfactorily rate their satisfaction with the system.

From a sample of 64 users of various systems, Mullany et al. (2006) tested the construct validity of the SSS by comparison with a single-scale, seven-point measure of user satisfaction which they called the 'construct validity scale' (see first scale, Appendix 1). The SSS was also compared with the UIS, administered to the same set of users. Both the associations and correlations proved to be highly significant at $p = 0.01$ and $p = 0.02$ respectively. Mullany et al. (2006) thus deduced that the SSS is a valid measure of user satisfaction. They suggest further that the SSS can be used repeatedly to obtain reliable results from the same user: this by positing that as each user complaint is respondent-generated, a user could be asked to re-evaluate each complaint at a future time, to discard complaints that are no longer current and to add new complaints and weightings. Further, they claim that reliable, repeated measurements of user satisfaction probably are impossible by any of the prior instruments they identify. In justification they posit that some of the items contained in these instruments are likely to be irrelevant to the user while others relevant to the user might be omitted. They also suggest that the user would find the repeated administration of such an instrument unconvincing; resulting in unreliable ratings and high attrition rates (Mullany et al., 2006).

As previously noted, the present study essayed to compare user satisfaction with the analyst-user cognitive gap over time. Hence on the grounds of its evident ability to measure user satisfaction repeatedly and its construct validity, the SSS was selected as our measure of user satisfaction.

The significance of cognitive style in IS research and practice

The significance of cognitive style in IS research stems from its role as an individual's approach to problem-solving (Liu and Gunther, 1999; Kirton, 1976, 2003). By developing a system, an analyst brings about change in the user's environment. Clearly, the *manner* in which this is done could affect the user and his/her enthusiasm for using the new system. The analyst's cognitive style dictates this manner. The user may or may not relate well to this manner. Hence, the

possibility that the analyst's cognitive style will impact the user's perceptions of the resulting system is evident; something which this study essayed to test.

Some recent scholarly IS studies tend to use the terms *cognitive* and *cognitive style* as though they have commonly accepted meanings and validities (Trauth and Cole, 1992). However, few empirical IS studies were found that successfully make use of the concept. Liu and Gunther (1999) define cognitive style as: "the individual's consistent and characteristic predispositions of perceiving, remembering, organizing, processing, thinking, and problem solving." According to this, a person's cognitive style is a consistent and characteristic approach to problem-solving. As a human characteristic, it suggests that the construct has a degree of stability with time. Kirton (1976) defines cognitive style similarly as "an individual's preferred approach to problem-solving" and (2003) as "an individual's *stable, preferred* manner in which (s)he brings about change." A person's cognitive style is thus stable with time, and is related to the characteristic way they "bring about change" or solve problems. In other words, cognitive style is a fixed characteristic of an individual's inherent mental perception and processing which dictates the way in which he/she prefers to solve problems and/or to bring about change.

Where cognitive style is pursued as a guide to IS research and practice, however, the literature is sparse and open to question. There are a number of ways of define and measuring cognitive style (Carey, 1991) but no consensus on the best of these for IS research, could be identified. Gregor and Benbasat (1999) in a literature survey, suggest that further work in the cognitive style area by IS research is warranted. Nothing significant has been found since, however. This evident lack of recent research into the empirical relationship(s) between user satisfaction and the cognitive styles of users was further noted by Banker and Kauffman (2004). In addition, cognitive style is identified to be of current interest in IS by Carey (1991), Trauth and Cole (1992) and Gregor and Benbasat (1999). The overall opinion of these authors is that one would expect users' cognitive styles to be related to system success, but as yet no study had convincingly shown how.

By contrast, Mullany (2005) demonstrated a positive association between the absolute analyst-user differential (or cognitive gap) and user resistance for a sample of 34 users, suggesting that cognitive style remains a viable area for IS research. He measured cognitive style using the Kirton Adaption-innovation Inventory (KAI), applied to both users and analysts. User resistance was measured using his 'R-Score', where R is the sum of the weightings of a number of complaints made by the user in private regarding problems associated with the system. The larger the cognitive gap (KAI score difference), the more complaints were made, and the more intense they tended to be. His study argued and empirically demonstrated that a user tends to be *least dissatisfied* when assigned to a systems analyst/developer of similar cognitive style, since the user will then recognize an approach to problem-solving in the analyst with which they are familiar and a consequent system solution which they are likely to trust. This result suggests the continuing importance and significance of cognitive style. However, Mullany used a measure of resistance as opposed to the similar measure of user satisfaction we used, and his study was based on a modest sample of only 34 systems.

Kirton's (1976, 2003) model of cognitive style is known as Adaption-Innovation (A-I) theory. According to this, an individual's preferred approach to problem solving occurs on a continuum ranging from high adaption to high innovation. Some human beings, called adaptors tend to prefer the adaptive approach to problem-solving, while others (innovators), prefer the reverse. Adaptors use what is given to solve problems by time-honoured

techniques. Innovators, however, look beyond what is given to solve problems and tend to use innovative technologies. Adaptors prefer to do well within a given paradigm, while innovators tend to do differently, thereby striving to transcend existing paradigms.

Kirton (1976) invented the KAI to measure cognitive style in accordance with A-I theory. This requires the respondent to rate themselves against thirty-two personality traits. A significant difficulty with most other measures of cognitive style is their failure to separate out cognitive style and cognitive level (or ability). This arises from the fact that most involve some type of psychological, perceptual or cognitive skill. For example, in Oltman et al.'s (1971) measure of cognitive style called the Group Embedded Figures Test (GEFT), the respondent is asked to distinguish a figure from a confusing background. This will clearly be a matter of visual and/or perceptual skill, as much as of cognitive style. The items on the KAI, on the other hand, are expressed in clear and simple language, so it is difficult to see how cognitive level could play any significant role, at least for respondents who are functional in English. Scores on the A-I continuum are normally distributed over a range from high adaptation to high innovation.

Research Questions and Hypotheses

Since several users can use one system and several systems can be used by one user, the combinations of users and systems proved to exhibit a many-to-many relationship. This study therefore took the basic research element to be a "user-system", or US. The chief omission identified in scholarly IS literature, then, was a lack of recent inquiries into the relationship between user satisfaction and the cognitive styles of a US's associated analyst(s) and user(s). This implies two specific gaps: the impact of the cognitive style differential on overall user satisfaction; and whether or not this impact varies over the period of a US's life. The prior study by Mullany (2005) showed a positive relationship between the number and intensity of user complaints and the analyst-user cognitive gap. As the SSS is largely the algebraic antipode of a record of user complaints, a negative relationship between the cognitive gap and the associated S statistic would be expected. Hence the first research question:

1. Does the cognitive differential between an analyst and an associated user negatively impact overall user satisfaction with a given system?

If the mean user satisfaction over time is taken as the overall satisfaction with a given system, this suggests the hypothesis:

H₁ There is a negative association between the analyst/user cognitive gap (absolute difference in KAI score), and the mean S exhibited by a user during a US's life.

As mentioned above, the varying impact of the cognitive gap on user satisfaction over system usage remained evidently uninvestigated prior to this study. This implies the second research question:

2. Does the impact of the analyst-user cognitive differential vary over USs' life-times? If so, what is the profile of this impact? Is it stronger at certain times during a US's life and weak at others?

Ideally, this question needs to be supported by a hypothesis which is tested at every point in time over a sample of USs' life-times. As this is impossible, the present study settled on estimated values of S for every day of usage. This enabled the formulation of the following hypothesis for daily testing:

- H₂** There is a negative association between the analyst/user cognitive gap (difference in KAI score), and the user's S-score on each day of a USs' life.

Owing to the gaps evident in the literature, this study was a pioneering effort. It was thus early recognized that the testing procedure might need to be modified and extended in the light of the first results obtained.

Methodology

The procedure involved two phases; data collection and data analysis. The KAI was employed to measure analyst and user cognitive styles, and the System Satisfaction Schedule (SSS) was used to measure user satisfaction (S), over time. This SSS instrument consists of four pages printed back-to-back on one sheet so that the whole document folds into a single four-leaf document. Page 1 records demographic, organizational and system data. Page 2 contains the overall satisfaction scale (or CVS), spaces for recording and rating users' complaints and a second scale for the ratings of the severities of each complaint. Page 3 is designed to facilitate readings over time, with columns for each occasion of measurement and cells within these for each of the complaint ratings. Page 4 contains detailed instructions for data collectors. The essentials of Page 2 are reproduced in Appendix 1.

The impact of the cognitive gap on S was measured as an association using Kendall's (1970) t_a statistic. The greater the size of t_a at a given time, the greater the impact of the cognitive differential was assumed to be. According to Kendall (1970), a sample of as few as ten data pairs is sufficient to achieve a statistically usable result for t_a . A principal research sample of 62 USs was selected, which would yield well over this minimum for most of the survey time. They were drawn from 12 organizations distributed over South Africa and New Zealand. As the presence of more than one analyst would contaminate the results, only single-analyst USs were selected. It should be noted that this sample was completely separate from the sample of 64 USs used in the pilot study, as discussed in Section 2.1. For allowing their staff to participate, organizations were offered a future set of the complete results. Neither individuals nor organizations would be identifiable from this. Organizations' agreement was obtained to allow all employees' responses to be kept private. The organizations took on the task of selecting staff, but were asked not to compel reluctant staff to participate.

Kirton's KAI was used to measure each user's and each analyst's cognitive style. At an initial face-to-face interview, the user's S was determined using the SSS. Between 3 and 7 S-readings were taken for each US. The frequencies of readings are summarized in Table 1.

No. Readings:	3	4	5	6	7
Frequency:	11	0	13	31	7

The composition of the 62 US sample, classified by system type, organisation and sector, is given in Table 2.

Table 2: Sample of 62 systems stratified by organization-type, system-type and sector

Type of organization		Type of system		Sector	
Manufacturing / industrial	34	Stock Control (manufacture)	9	Private Sector	44
Transport and shipping	14	Stock Costing (factory works)	9	Public Sector	18
Banking	5	Motor Fleet Control and/or Maintenance	8	Total:	62
Insurance	5	Manufacturing Control	6		
Educational	4	Customer Accounts (industrial)	5		
Total:	62	General Accounting	5		
		Point of Sale	4		
		Purchasing (industrial)	4		
		Security/Surveillance (industrial)	4		
		Mortgage Processing (bank)	2		
		Student Records	2		
		Insurance Claims	1		
		Office Automation	1		
		Telecommunications, bank cards	1		
		Works leasing	1		
		Total:	62		

The data thus made available were four sets of initial readings for each sample US, as follows:

- the number of days since the user began (or until the user did begin) interacting with the working system,
- the user's cognitive style as a KAI-score,
- the analyst's cognitive style as a KAI-score, and
- the user's satisfaction with the system as an initial S value.

Thereafter, with the aid of the telephone, user S-values were obtained for each US at approximately 90 day intervals. 320 readings were recorded for S, spread over the sample of 62 USs, and were plotted on a common time domain from 0 to 730 days. A set of S-readings for each US on each day of the analysis was estimated using the process of linear interpolation (Steffens and Strydom, 1999). In effect, every sample US then was assigned an S-value, either read or estimated, on each day of its life within the 0-730-day time-window. As fewer than 10 USs (the minimum as specified by Kendall (1970)) were in existence prior to day 15 or after day 702, readings made outside this time-range were excluded from the analysis. During each telephonic interview, notes were made of any unexpected and unusual circumstances or occurrences which had significantly impacted the user's satisfaction since the previous interview. A key objective of this was to detect any significant peaks, troughs or sudden changes in S which could have rendered the interpolated estimates of S unacceptably inaccurate. At no time were any such changes detected. Hence the interpolated estimates of S were assumed to be sufficiently accurate for valid, daily calculations of t_a . This is further supported by the fact that t_a is a non-parametric statistic, meaning that data ranks rather than accurate data values are used in its calculation (Kendall, 1970).

Results and Discussion

As noted above, 320 user ratings of their own user-generated factors were collected and diarized over the entire survey. Every factor was a description of experiences associated with past system

usage and none suggested any expectations about future usage. This vindicated Mullany et al.'s (2006) speculation that user satisfaction is based on memories of past system usage.

General description of the data

Each US yielded between 3 and 7 readings for S, taken at approximately 90-day intervals since initiation. The number of USs contributing data at every point in time along the domain was plotted. It became evident that at no time were all 62 USs contributing data anywhere on the domain, the maximum being 52 at, and in the neighborhood of day 390 (see Figure 1).

The curve of the mean-S for the interpolated values for all USs existent on each day is given in Figure 1 as the curve ABCDEF. Observation of this curve showed that it could be divided

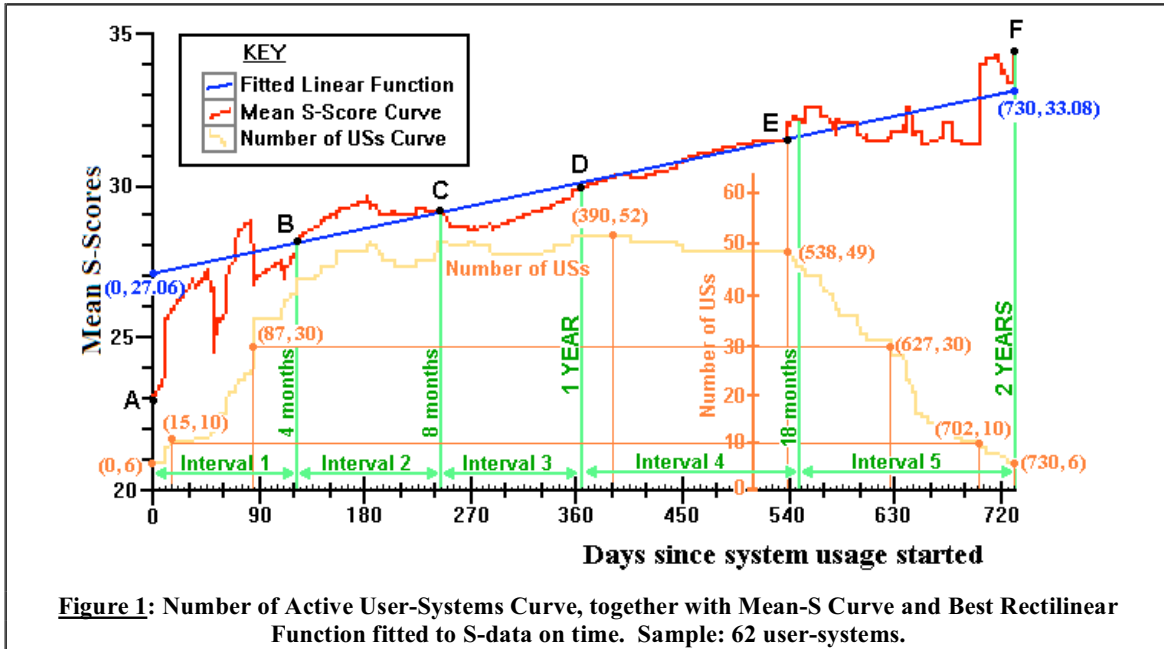


Figure 1: Number of Active User-Systems Curve, together with Mean-S Curve and Best Rectilinear Function fitted to S-data on time. Sample: 62 user-systems.

meaningfully for discussion into five; the first year of usage into 3 intervals of 4 months and the second year into two intervals of 6. For convenience these were labeled Interval 1 to Interval 5 as shown in Figure 1. It is also evident from Figure 1 that the mean-S curve fluctuates in an irregular manner over arc AB on Interval 1, suggesting that this is a period of uncertainty in the users' attitude towards a new system. In Intervals 2 to 4 less irregularity occurs, and is an approximately upward linear trend. During Interval 5, however, the number of USs contributing data begins significantly to fall. Immediate, concurrent irregularity in the mean-S curve occurs (see arc EF).

A method for fitting polynomial curves of increasing order, as outlined by Zar (1999), revealed that the best-fitting polynomial function was an ascending straight line, shown in blue in Figure 1.

The overall impact of the analyst-user cognitive gap

Hypothesis H₁ posits a negative association between the analyst-user cognitive differential and the mean S-values measured for each US. The absolute analyst-user KAI difference on the mean for all readings was found to exhibit a Kendall-t_a value of -0.1660, significant at p = 0.05. While this significance level is an acceptable one in the biological and human

sciences (Zar, 1999), the actual value of the result is rather weak. If the value of $t_a = -0.1660$ is an accurate estimate of the population's τ_a , then a maximum discordance of 58.3 % occurs in the population of USs (Kendall, 1970). This is not very far from 50%, which is the point of independence (Kendall, 1970).

One should note, however, that the above result does not show that the cognitive differential always has a weak impact on user satisfaction. It could be that hypothesis H_1 posits too simplistic a model of the impact of cognitive style on user satisfaction. The significance of cognitive style could well vary over the time domain. In certain regions, it could be very strong, as speculated in Section 3 and as testable by the day-wise testing of hypothesis H_2 . Despite its evident weakness, the above result is statistically significant, suggesting that a small analyst-user cognitive differential is at least one of a number of key factors which contribute to user satisfaction. Hence it indicates a recommendation for system development and maintenance: to help optimize user satisfaction, match the user and analyst as closely as possible in cognitive style. As the KAI is inexpensive and quick to administer, this instrument could be used to establish the cognitive styles of all an organization's users and analysts. It would thus be feasible either to match users and analysts cognitively, or if that is not possible, to predict a level of dissonance between them.

The relevancy of the analyst-user cognitive gap during system usage

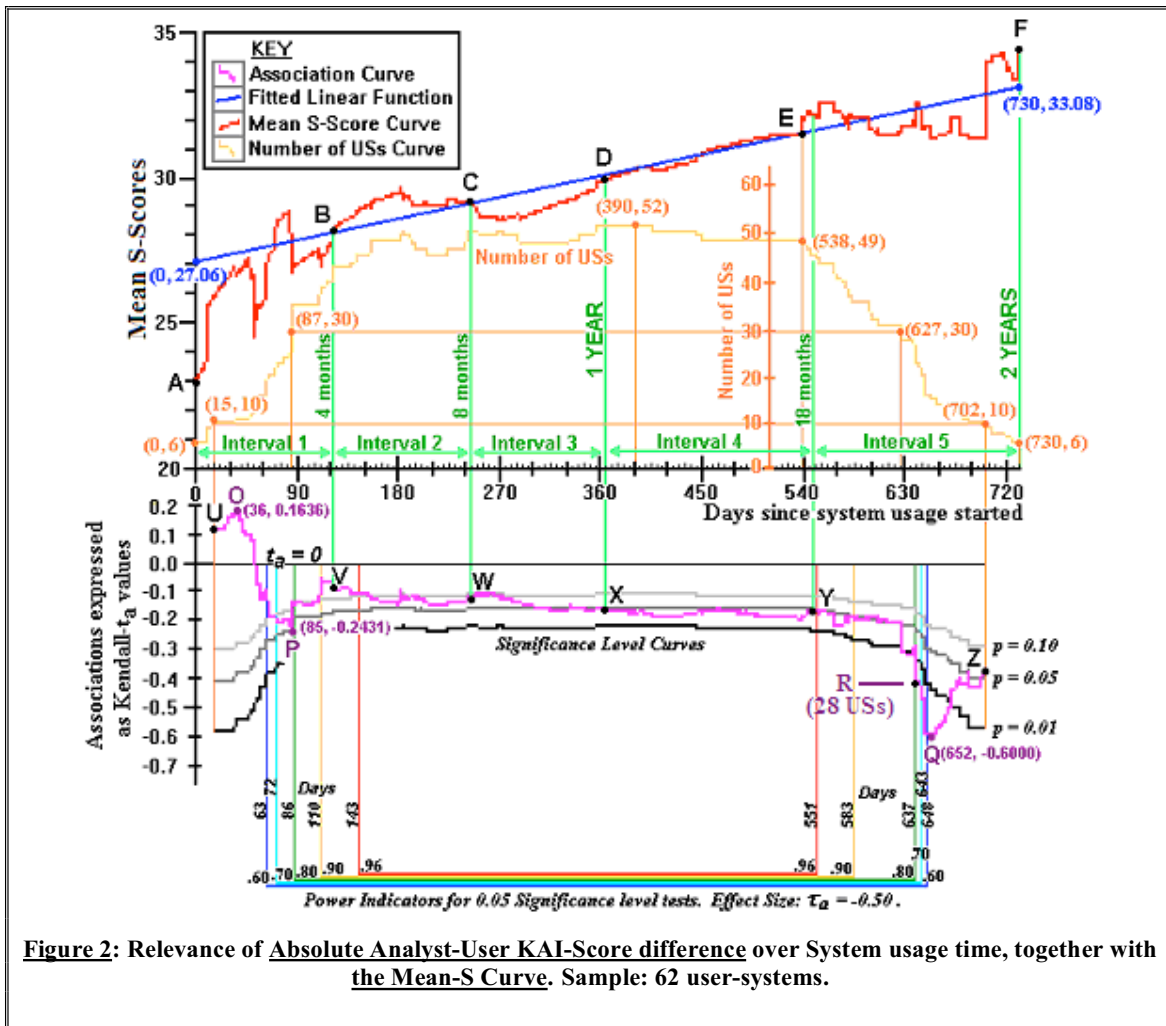
This part of the analysis involved the testing of hypothesis H_2 , and as discussed above, to find where on the time domain, H_2 can be supported, and with what strength. To this end, a graph of the impact or relevancy of the absolute analyst-user KAI difference (as Kendall t_a values) on time was plotted and added to the composite of the mean-S and US-number curves as shown in Figure 2 as the curve UOPVWXYQZ. Power indicators for the 0.05 significance level test and effect size of $\tau_a = 0.5$ were determined as outlined by Cohen (1988) and added to Figure 2.

As is evident from Figure 2, the absolute cognitive gap impacts user satisfaction in all five intervals over the two-year period, and indeed over most of the time domain. However, the value of t_a only exceeds an absolute value of 0.2 in the neighborhoods of points P and Q. At P, the implication is that a short period of particular sensitivity to the cognitive gap is likely to occur during the first four months of system usage, and the strength of any accompanying dissatisfaction is associated with the size of the cognitive gap. At Q, when USs are in the process of terminating, the size of the cognitive gap is even more salient. This study found therefore that as USs terminate, dissatisfaction just prior to termination is highly associated (80% maximum discordance at its peak) with the cognitive gap. This suggests that most users express their greatest dissatisfaction just prior to US termination with systems developed by analysts of differing cognitive style, the dissatisfaction and cognitive gap being highly positively associated.

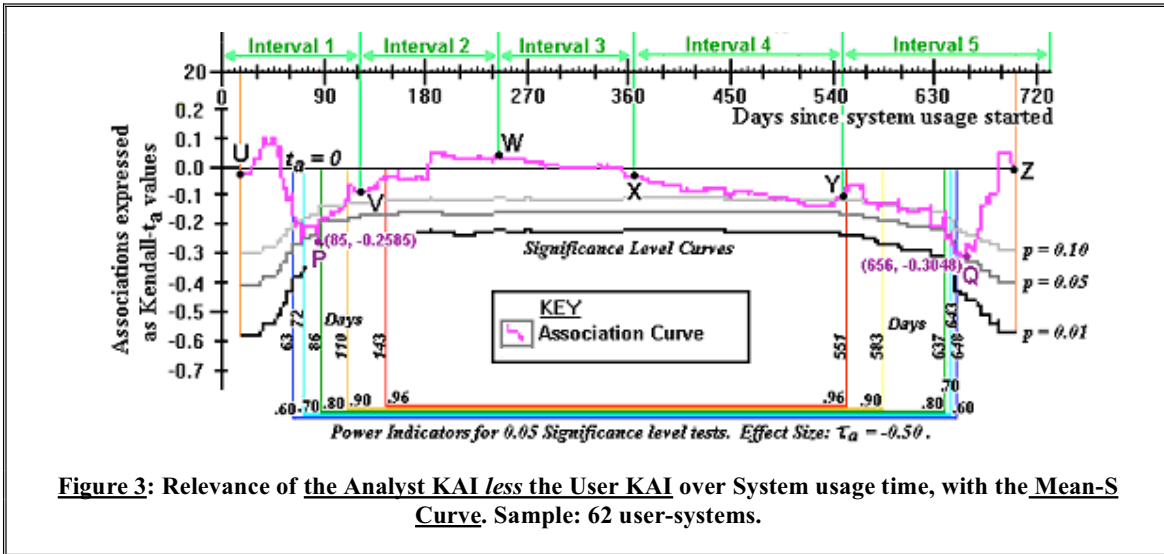
A further examination of the relevancy curve in Figure 2 helps explain the low sizes obtained for t_a for the associations between the overall mean S and the absolute cognitive gap (see Section 5.2). The cognitive gap is seen to be low but relevant, at least at $p = 0.10$, almost everywhere on the domain. The only exceptions are in the neighborhoods of P and Q where $|t_a|$ is much larger (see Figure 2). For purposes of explanation, significance curves have been inscribed on to the diagram. Where the relevancy curve occurs below one of these, H_2 is supported at the corresponding significance level. It will be noted that points P and Q exhibit significance levels of 0.05 and 0.01 respectively. The bands at the bottom give the powers of

$p = 0.05$ significance level tests with an effect size of $\tau_a = 0.5$. Attention is drawn to the fact that the powers range from 0.80 to 0.96 over the portion of the time domain to which this discussion applies.

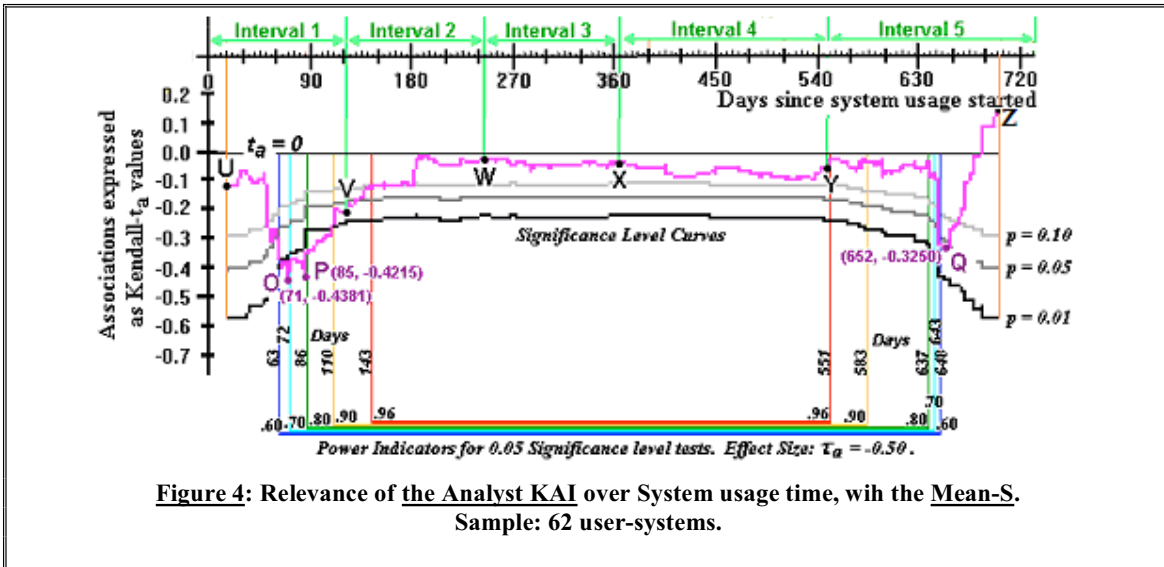
P and Q are just two points, so the *average* relevancy of the cognitive gap over the whole domain would be expected to be significant, but low, providing further confirmation for hypothesis H_1 . This study proposes in consequence that an attempt to find an association between a cognitive measure and some measure of user satisfaction, taken as once-off readings from a sample of systems, can expect the result to be significant, but low. It thus is not surprising that authors such as Carey (1991) could find little evidence for the value of cognitive style in system development or research.



For completeness, we also plotted the impact of the cognitive gap as the signed value of analyst KAI score less user KAI score (see Figure 3).



As will be seen from Figure 3, the curve produced is similar to the last, peaking negatively at 85 and at 656 days, with corresponding t_a values of -0.2585 and -0.3048. This exhibits an interesting comparison with the previous profile (Figure 2), in that the signed cognitive gap's impact is slightly higher in Interval 1 than anywhere else. In Interval 5, however, it is



definitely lower. This suggests an asymmetric effect of the cognitive gap. In Interval 1, the more innovative nature of the analyst causes about as much dissatisfaction as the absolute difference in cognitive style between analyst and user. In Interval 5, however, the implication is that the absolute cognitive gap impacts user satisfaction more than the innovativeness of the analyst. This led to the conclusion that the innovativeness of the analyst outweighs that of the user in impacting user satisfaction. This conjecture was tested by plotting the impact of the analysts' cognitive styles against time. The resulting profile is given in Figure 4.

As is evident from Figure 4 and based on the research sample and tests, the posit that the innovativeness of the analyst does negatively impact user satisfaction in the vicinities of P and

Q is supported. Another point O (72 days, $t_a = -0.4381$) also exhibited a strong impact. In short, analysts innovative with respect to their users, are associated with higher user dissatisfaction during the first and last few months of system usage than are analysts adaptive with respect to their users.

The association between the user's KAI scores and the impact on S was not supported, either by any of the preceding theory or results. However, for completeness an attempt was made to repeat the above with the users' KAI scores only. As expected, nowhere along the time domain did the profile reach the $p = 0.05$ significance curve, and so further consideration was abandoned.

Implications for practice

The cognitive styles of users and analysts are cheaply and easily measured using the KAI. Our study demonstrates the overall effect of the cognitive gap on users as well as the time-regions where this gap is likely to have most impact. It thus has significant implications not only for analysts and users, but also for managers who are engaged in setting up teams of analysts and users. The significant association of the cognitive gap with the mean S for each US suggests that overall user satisfaction can be increased by matching the analyst and user cognitively. At first sight, this appears to be of little significance since the association is rather weak. However, the impact of the absolute cognitive gap has been shown to be strong in the vicinity of the 85th and 652nd days of system usage at points P and Q respectively (see Figure 2). 26 USs contributed data at P, which is well above twice the minimum sample size suggested by Kendall (1970). Hence this study accepted the significance of t_a at P and so alerts practitioners that towards the end of the third month of usage, a large cognitive gap could be associated with the early failure of a system.

At Q only 16 USs were contributing data. Although this exceeds the minimum of 10 specified by Kendall (1970), the sample is small. However, the curve is significant at $p = 0.01$ at R (day 637), where 28 USs contributed data (see Figure 2). The study thus accepted the high significance of t_a in this region. The direct implication is that a high cognitive gap may cause system failure at this stage. This may sometimes be beneficial as it could help wean the user off an old system which has been scheduled for replacement. One needs to be alerted, however, that reasons advanced for terminating a system may be based on cognitive dissonance rather than on any intrinsic defects of the system.

Finally, the effect of the relevancy of the cognitive gap was found to be asymmetric, meaning that a user tends to be more dissatisfied with USs associated with a more innovative analyst than a more adaptive one. Hence where perfect cognitive matching cannot be achieved, one should assign to a US, where possible, an analyst who is more adaptive than the user.

Conclusion and Future research

We believe that our study has added credibility to the SSS and associated S statistic as based on memories of past usage. In confirmation, we found that issues of future usage did not primarily come to the mind of any respondent when focusing on their satisfaction with the system. This makes it evident that the respondents themselves associated their satisfaction or dissatisfaction with their past system experience only, not on future expectations.

We do not think that our results were affected appreciably by the use of USs with varying life spans. However, we encourage replication of our research using samples of systems with

more similar lives over shorter regions of the time domain. For instance, systems in their first three months of usage could form the basis of a further investigation.

While this study focused on system usage, system development is not normally completed by the commencement of usage. It usually continues as part of the early maintenance, or as part of a phased or pilot conversion (Capron and Johnson, 2002). Similarly, system maintenance often takes place concurrently with system use. Hence one might speculate that the results which have been obtained for system usage could well apply to periods of system development and maintenance. We suggest an investigation into the effect of the cognitive gap on user attitudes during these phases as additional areas for further research.

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Appendix 1

System Satisfaction Schedule (Abridged from Page 2)

Please rate your satisfaction with the system on the following scale:

(7)	(6)	(5)	(4)	(3)	(2)	(1)
<i>Extremely</i>	<i>Quite</i>	<i>Slightly</i>		<i>Slightly</i>	<i>Quite</i>	<i>Extremely</i>
	<i>Satisfied</i>				<i>Dissatisfied</i>	

Please enumerate all the problems you or others find with the system:

Original instrument has 18 lines for complaints

Please rate each complaint according to its severity on the following scale:

(7)	(6)	(5)	(4)	(3)	(2)	(1)
<i>an extremely</i>	<i>a very</i>	<i>a serious</i>	<i>a rather</i>	<i>a significant</i>	<i>a slight</i>	<i>no real</i>
<i>serious/totally</i>	<i>serious</i>	<i>problem</i>	<i>serious</i>	<i>problem</i>	<i>problem</i>	<i>problem</i>
<i>insoluble problem</i>	<i>problem</i>		<i>problem</i>			
