

BRIEF COMMUNICATION

Users' Personality and Perceived Ease of Use of Digital Libraries: The Case for Resistance to Change

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The use of digital libraries has seen steady growth in the past two decades. However, as with other new technologies, effective use of digital libraries depends on user acceptance, which in turn is affected by users' perception of the system's ease of use. Since the introduction of new technologies often involves some form of change for users, the recent identification of the resistance to change (RTC) personality trait, and the development of a scale to measure it, provides an opportunity to assess the impact of RTC on new users of a digital library system. Drawing on prior research focused on personal differences and system characteristics as determinants of perceived ease of use, in the present study we explore the relationship between RTC and perceived ease of use of a university digital library. The results of a survey of 170 new users of the library system suggest that RTC is a significant determinant of perceived ease of use, and improves the explanatory power of previous technology-acceptance models. Implications of the findings are discussed.

Introduction

The use of digital libraries has grown significantly in the past two decades (Thong, Hong, & Tam, 2002). As with other new technologies (Venkatesh, Morris, Davis, & Davis, 2003), user acceptance is key to the effective use of digital libraries. Perceived ease of use (PEOU) has been identified as one of the key factors that motivates individuals to accept and use specific technologies (e.g., Davis, 1989), including

digital libraries or their component services (Hong, Wong, Thong, & Tam, 2002; Kim, 2006). PEOU, however, captures the aggregated effects of a set of upstream factors that represent individual differences, organizational influences, and system characteristics (see, e.g., Agarwal & Prasad, 1999; Lewis et al., 2003). Therefore, in order to guide designers, implementers, and managers of digital libraries, and consequently to enhance user acceptance and prevent underutilization, a good understanding of what factors strengthen or weaken the digital-library users' PEOU is required.

Studies have found PEOU to be influenced by characteristics of the technology on one hand, and individual differences among the prospective users on the other hand (Hong et al., 2002). Individual differences such as personality traits determine how individuals think and behave in different situations. Therefore, personality traits are commonly used in psychological research to explain beliefs and behavior (Digman, 1990). Introduction of new technologies often involves some form of change for users. Therefore, the recent identification of the resistance to change (RTC) personality trait, and the development of a scale to measure it, provides an opportunity to assess the impact of RTC on the PEOU of users with the introduction of a new digital library system. This is the goal of the present study (see Figure 1 below).

Background and Literature Review

Digital libraries offer the potential to greatly improve how individuals search and retrieve information (Borgman, Smat, Milwood, & Finley, 2005). However, as with other information systems, user acceptance is a key factor in the success and full utilization of digital libraries. The technology acceptance model (TAM; Davis, 1989) is the most widely

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used conceptual model in the technology-acceptance literature. Following the introduction of TAM, numerous studies have replicated and extended Davis' work (e.g., Lee, Kozar, & Larsen, 2003), including some in the realm of digital libraries (e.g., Hong et al., 2002; Kim, 2006; Thong et al., 2002).

According to TAM, perceived usefulness (PU) and perceived ease of use (PEOU) are the two key user beliefs affecting intention to adopt a technology. Given the importance of PU and PEOU in determining user acceptance, researchers have taken great interest in identifying the antecedents of these user beliefs. For PEOU, researchers have identified two main categories of antecedents (Hong et al., 2002), namely, system characteristics and individual differences. System characteristics such as compatibility (Karahanna et al., 2006) and objective usability (Venkatesh & Davis, 1996), as well as individual differences in computer self-efficacy and computer anxiety (e.g., Venkatesh, 2000) were found to influence PEOU.

Though research is advancing the understanding of PEOU antecedents stemming from individual differences, this area of research still requires more work. As pointed by Lee et al. (2003) "a deeper understanding of factors contributing to ease of use and usefulness is needed" and "more efforts to examine the broader environmental factors including . . . personality difference . . . are necessary." (pp. 766–767).

Personality and Information Technology

The psychology literature has long used personality as a predictor of human beliefs and behavior. There is substantial evidence for personality traits' role as predictors of beliefs and behavior, across a variety of contexts (see, e.g., Mischel, 2004; Pulford & Sohal, 2006). For example, the personality trait of agreeableness was linked with inhibition of verbally aggressive behavior (Smits & De Boeck, 2007), organizational citizenship behavior (Ilies, Scott, & Judge, 2006), and consumerism and environmentalism (Hirsh & Dolderman, 2007). Recently, there has been a growing interest in using personality as an explanatory tool in the literature to help us understand people's use of information technology (Devito Da Cunha & Greathead, 2007; Oreg & Nov, 2008; and Pratt & Chudoba, 2006). It has been shown that personality traits predispose technology users to behave in certain ways under different situations (Thatcher & Perrewé, 2002). For example, the personality trait of extraversion was shown to be positively related to users' initial acceptance of ERP (Enterprise Resource Planning) systems (Pratt & Chudoba, 2006); the trait of openness to experience was found to moderate the effect of computer-assisted communication on decision-making performance of teams (Colquitt, Hollenbeck, Ilgen, LePine, & Sheppard, 2002); and the traits of emotional stability and extraversion were found to moderate the relationships between the paths in a model of monitoring acceptance, such that people who scored lower in extraversion and emotional stability were less likely to endorse positive attitudes toward monitoring in the workplace (Zweig & Webster, 2003).

Resistance to Change and Technology Acceptance

One aspect of human behavior critical for technology acceptance is resistance to change. Introduction of new technologies often involves some form of change for the users. Such a change could be as minor as a simple modification of the user interface, or as profound as a complete alteration of the way an individual accomplishes a certain daily task. Different users may react differently to changes. Some might welcome these changes, while others might resist them. User resistance to changes brought about by new technologies is often the main reason an information-technology project fails (Venkatesh, Morris, & Ackerman, 2000).

User resistance has been seen as central to IT-enabled change (Manzoni & Angehrn, 1997), and the relationship between technology adoption and resistance to change has been studied widely: users' resistance was shown to affect IT implementation (Markus, 1983; Cooper & Zmud, 1990), and changes in job content have been shown to underpin resistance to adopting new technologies (e.g., Jiang, Muhanna, & Klein, 2000). Markus (1983) suggested that resistance to change associated with the introduction of a new system decreases the power shift intended to be achieved with the new technology.

Recently, advances in social psychology research have shown that individuals' resistance to change is more than just an overt behavior in specific situations. Building on previous research that examined the relationship between personal differences and coping with change (e.g., Judge, Thoresen, Pucik, & Welbourne, 1999), researchers have identified individuals' dispositional inclination to resist changes as a fundamental personality trait (Oreg, 2006). This trait is termed *resistance to change* (RTC; Oreg, 2003, 2006). The RTC trait consists of four related, yet distinct, dimensions: routine seeking, emotional reaction to change, short-term focus, and cognitive rigidity, where each dimension reflects a different source of resistance. The RTC trait has been linked to people's behavior under conditions of change in a variety of contexts (Oreg, 2003; van Dam, 2005): people differ from each other in their inclination to resist or adopt changes, and the RTC disposition can therefore explain why some people are more inclined than others to try to adopt new products, including new technologies (Oreg, Goldenberg, & Frankel, 2005). The RTC scale, developed to measure the RTC trait, consists of 17 items, and a number of studies (e.g., Oreg, 2003, 2006) have established its convergent, discriminant, and predictive validities, as well as its internal consistency and its test-retest reliabilities. The 17 items reflect the four dimensions of the RTC construct. These include, for example, "I generally consider changes to be a negative thing" (routine seeking), "When things don't go according to plan, it stresses me out" (emotional reaction to change), "Changing plans seems like a real hassle to me" (short-term focus), and "I don't change my mind easily" (cognitive rigidity). The RTC trait has been shown to predict specific change-related behaviors above and beyond other related personality characteristics, such as

tolerance for ambiguity (Budner, 1962) or risk aversion (Slovic, 1972), and has recently been used to analyze people's behavior in the context of change and innovation (e.g., Moldovan & Goldenberg, 2004).

According to behavioral research, when trying to predict behavior in a particular context, narrow and specific traits may yield stronger relationships than those found with more general traits (Jones, Reynolds, Weun, & Beatty, 2003; Schneider, Hough, & Dunnette, 1996). Oreg et al. (2005) drew on this research to introduce the concept of domain-specific resistance to change, and developed a measurement scale consisting of one item from each of the general RTC dimensions, tailored to the specific domain investigated.

Research Model

Motivated by the need to explore the effects of personality traits on PEOU (Lee et al., 2003) on one hand, and the potential usefulness of the RTC trait in understanding resistance to digital-library adoption on the other hand, in the present study we aim to understand the effect of RTC on new users' PEOU of a digital library. Consistent with findings from prior research on antecedents of PEOU of digital libraries (e.g., Hong et al., 2002), we incorporated two system characteristics, screen design and relevance, and two personal differences, computer anxiety and computer self-efficacy. Our research model is illustrated in Figure 1.

Personal Differences Hypotheses

PEOU represents the extent to which a user believes that using the technology will be effortless (Davis, 1989). PEOU will be relatively low the more the user's perception is that mental or physical efforts are required during the initial adoption of a new technology. By definition, people who have higher resistance to change are those who find it hard to break away from routines, are emotionally stressed in the face of change, and find it cognitively difficult to change their minds. Therefore, individuals with higher resistance to

change are expected to be disinclined to try out new things such as new technologies, because even when a new technology can bring significant benefits, the act of learning and using a new technology is psychologically difficult for them (Oreg, 2003). In other words, regardless of how useful they might think the new technology will be, they will think it difficult to use due to the changes entailed.

In an empirical study of RTC and office relocation, it was found that those who have high RTC reported an increased difficulty in working effectively in the new place (Oreg, 2003). Viewed within the context of digital libraries, the ease of working in the new environment can be compared to the ease of working with a new library system. We would therefore expect that those who are high in RTC will perceive a new digital library to be relatively difficult to use:

Hypothesis 1: RTC will be negatively related to PEOU of a digital library.

Computer self-efficacy, defined as an individual's judgment of her ability to use a computer technology (Compeau & Higgins, 1995), has been shown to be an antecedent to PEOU (e.g., Venkatesh & Davis, 1996; Agarwal et al., 2000; Hong et al., 2002). When an individual assesses the effort expected in using a computer technology, her evaluation of her ability to perform computer-related tasks would likely be a crucial element in the assessment. The more she believes in her ability, the less effort she would expect. Therefore, we hypothesize that

Hypothesis 2: Computer self-efficacy will be positively related to PEOU of a digital library.

Computer anxiety, defined as user apprehension or fear when he faces the possibility of using computers (Simonson, Maurer, Montag-Torardi, & Whitaker, 1987) and the implications of computer use such as the loss of important data or possible mistakes (Sievert, Albritton, Roper, & Clayton, 1988), was found to affect various variables such as intention,

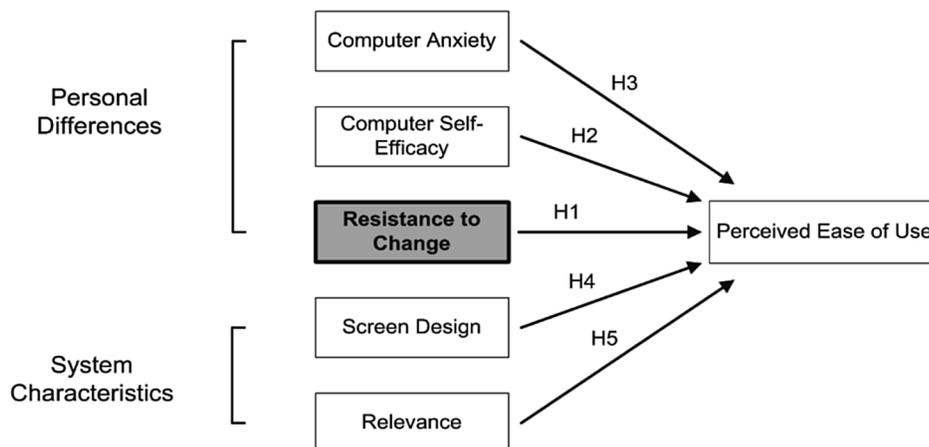


FIG. 1. Research model.

behavior, and performance (Venkatesh, 2000). Venkatesh also showed that computer anxiety has a negative effect on PEOU. Therefore, we expect

Hypothesis 3: Computer anxiety will be negatively related to PEOU of a digital library.

System Characteristics Hypotheses

System characteristics were shown to be reliable antecedents of user beliefs in TAM (e.g., Davis, 1993). The characteristics that matter to the users could differ substantially from one type of system to another. Therefore, we include relevance and screen design, two system characteristics that have been shown to be salient and significant antecedents to PEOU of digital libraries (Hong et al., 2002). People always interact with a digital library through the user interface on a computer screen. How well a user interface is designed greatly impacts how effectively users can achieve desired goals with a computer system (Jarvenpaa, 1989). A well-designed user interface will have all the UI elements organized and presented on the screen in a way that enables the user to navigate the features of the system with ease. Empirical studies have also shown that screen design is a determinant of PEOU of digital libraries (e.g., Hong et al., 2002). We expect to find similar results in this study:

Hypothesis 4: Screen design will be positively related to PEOU of a digital library.

Relevance refers to how well a computer system matches the tasks users need to carry out with it. The relevance of a digital library is mainly judged by how well it can help users to find the exact information they are looking for (Hong et al., 2002). Studies have found that users highly value the ability of a library system to find documents of high relevance (e.g., Janes, 1994). The more relevant information a user can find through a library information system, the more likely she will perceive it to be easy to use. The impact of relevance on PEOU has also received empirical support (e.g., Hong et al., 2002). Therefore, we make the following hypothesis:

Hypothesis 5: Relevance will be positively related to PEOU of a digital library.

Methodology

Participants and Settings

The setting of the present research is the library of a university in the northeastern U.S. The library provides a Web-based digital library system that enables users to locate books and periodicals, and access numerous Web-based databases of periodicals, such as EBSCO and Proquest. New students, who are the potential users of the system, take part in a one hour in-class instruction session as part of their first-year curriculum. Since these potential users are all new students, the

instruction provides us an opportunity to examine users' perceptions toward a digital library that is new to them.

A survey was administered to 244 students immediately at the end of the introduction session. 222 students returned the questionnaire. Participation was voluntary and no incentive was provided. After dropping responses from incomplete questionnaires and those with excessive missing data (for example, more than one missing item in any multi-item measurement), we had 170 usable responses. This yields a response rate of 70%.

Measures

We used Oreg et al.'s (2005) domain-specific RTC scale, adjusted to the context of digital-library usage. Computer self-efficacy and computer anxiety items were adopted from Venkatesh et al. (2003). Screen design and relevance items were adopted from Hong et al. (2002), and PEOU items were adopted from Moore and Benbasat (1991). All of the motivation items in the questionnaire were presented as statements with which respondents were asked to state how strongly they agree or disagree on a scale of 1 to 7. Example items for each of the constructs used are "If I were to use the system, it would be easy to use" (PEOU), "I often feel a bit uncomfortable trying out new computer software, even though it may be beneficial to me" (domain-specific RTC), "It scares me to think that I could lose a lot of information using the system by hitting the wrong key" (computer anxiety), "I could complete a job or task using the system if I could call someone for help if I got stuck" (computer self-efficacy), "The system commands are well depicted by buttons and symbols" (screen design), "The system has enough resources for my studies" (relevance).

Results

Instrument Validation

To validate our measures, we conducted a principle-component analysis (PCA) with varimax rotation using SPSS. It produced a six-factor solution as expected. Two items, however, did not load onto their intended constructs: one item for computer anxiety ("I feel apprehensive about using the system") loaded onto relevance with a .505 loading. One item for computer self-efficacy ("I could complete a job or task using the system, if there was no one around to tell me what to do as I go") loaded onto PEOU with a .510 loading. These two items were dropped and excluded from all subsequent analyses. All retained items were subjected to another PCA analysis and found to have higher than 0.6 factor loadings and less than 0.4 cross-loading in the PCA. The six-factor solution explained 71% of the total variance. Table 1 presents the mean, standard deviation, and factor loading of each measurement item.

To further assess factor validity, we also calculated the average variance extracted (AVE) for each measure (Fornell & Larcker, 1981). Each factor has an AVE above the .50 threshold, and the square root of AVE is higher than the

TABLE 1. Item means, standard deviations, and factor loadings.

| | Mean | SD | 1 | 2 | 3 | 4 | 5 | 6 |
|----------------------------|------|------|-------------|-------------|-------------|-------------|-------------|-------------|
| 1 PEOU 1 | 5.54 | 1.10 | .780 | | | | | |
| PEOU 2 | 5.27 | 1.16 | .771 | | | | .335 | |
| PEOU 3 | 5.38 | 1.30 | .673 | | -.376 | | | |
| 2 RTC-Domain 1 | 4.20 | 1.58 | | .790 | | | | |
| RTC-Domain 2 | 2.81 | 1.34 | -.362 | .679 | | | | |
| RTC-Domain 3 | 2.64 | 1.50 | | .691 | | | | |
| RTC-Domain 4 | 3.70 | 1.61 | | .766 | | | | |
| 3 Computer Anxiety 1 | 2.59 | 1.62 | | | .853 | | | |
| Computer Anxiety 2 | 2.52 | 1.27 | | | .856 | | | |
| 4 Computer Self-Efficacy 1 | 5.52 | 1.13 | | | | .821 | | |
| Computer Self-Efficacy 2 | 5.40 | 1.25 | | | | .785 | | |
| Computer Self-Efficacy 3 | 5.07 | 1.47 | | | | .723 | | |
| 5 Screen Design 1 | 4.94 | 1.19 | | | | | .819 | |
| Screen Design 2 | 4.97 | 1.19 | | | | | .874 | |
| 6 Relevance 1 | 5.18 | 1.20 | | | | | | .848 |
| Relevance 2 | 5.11 | 1.17 | | | | | | .823 |

Note: Factor loadings below .300 are suppressed.

correlation with other factors, demonstrating discriminant and convergent validity (Chin, 1998; Straub, Boudreau, & Geffen, 2004). All constructs have Cronbach’s alpha values that satisfy the generally agreed upon lower limit of .70 for confirmatory research (Straub et al., 2004), indicating that all measures are reliable. Table 2 presents the intercorrelations among the variables and their AVEs.

We then calculated the correlations among the independent variables and the dependent variable. They ranged from .004 to .380 (Relevance with PEOU). All correlations between predictor variables were lower than .50. This will help us to achieve better predicting power and clear interpretation of the results from our regression analysis.

Since we collected all data in a cross-sectional survey, we carried out Harman’s one-factor test (Harman, 1967) to examine the possible issue of common method bias. Six factors emerged with eigenvalues greater than one in an unrotated principal-component analysis of all independent and dependent variables. While one factor contributing to more than 50% of total variance is considered an indication of common method bias, the first factor in our analysis accounts for only 23% of the total variance. This indicates that common method bias is not likely to be a serious problem in this study.

Hypotheses Testing

Table 3 lists the results from regression analysis using SPSS with PEOU as the dependent variable. With all predictors except RTC entered in Step 1 of the regression, the model is significant overall ($F = 16.107$, $df = 4$, $p < .001$), with an adjusted R^2 of .26. After entering RTC in the independent variables in Step 2 of the regression analysis, the regression coefficient for RTC is significant in the predicted direction, and the adjusted R^2 was improved to .281, with a ΔR^2 of .02. This result is consistent with Hypothesis 1.

The coefficients of computer anxiety, computer self-efficacy, screen design, and relevance were significant in the predicted directions both in Step 1 and Step 2. These results are consistent with Hypotheses 2–5.

Discussion and Conclusions

Addressing the relationship between resistance to change and acceptance of digital libraries, the present study draws on the research on the RTC personality trait, which has been well established in the social psychology and innovation

TABLE 2. Means, standard deviations, reliability, intercorrelations, and average variance extracted.

| Construct | Mean | SD | α | 1 | 2 | 3 | 4 | 5 | 6 |
|---------------------------|------|------|----------|-------------|-------------|-------------|-------------|-------------|-------------|
| 1. Perceived Ease of Use | 5.40 | 0.95 | .72 | .743 | | | | | |
| 2. Resistance to Change | 3.34 | 1.12 | .73 | -.209** | .733 | | | | |
| 3. Computer Anxiety | 2.55 | 1.28 | .71 | -.292** | .215** | .854 | | | |
| 4. Computer Self-Efficacy | 5.34 | 1.02 | .70 | .261** | -.004 | .018 | .778 | | |
| 5. Relevance | 5.14 | 1.06 | .75 | .380** | -.104 | -.092 | .292** | .847 | |
| 6. Screen Design | 4.95 | 1.08 | .77 | .353** | .046 | -.097 | .163* | .365** | .835 |

Note: The diagonals are the square root of the AVE of each factor.

* Significant at the .05 level, one-tailed test; ** Significant at the .01 level, one-tailed test.

TABLE 3. Regression results.

| | Independent variables | Step 1 | | | Step 2 | | | |
|----------------------------------|------------------------|---------|-------------------------------|------|---------|-------------------------------|------|--|
| | | β | t | p | β | t | p | |
| Results of individual predictors | Constant | | 6.580 | .000 | | 7.019 | .000 | |
| | Computer Anxiety | -.253 | -3.799 | .000 | -.221 | -3.279 | .001 | |
| | Computer Self Efficacy | .162 | 2.341 | .020 | .164 | 2.394 | .018 | |
| | Screen Design | .218 | 3.065 | .003 | .235 | 3.322 | .001 | |
| | Relevance | .230 | 3.134 | .002 | .211 | 2.885 | .004 | |
| | Resistance to Change | - | - | - | -.150 | -2.228 | .027 | |
| Results of the overall model | R^2 | | .28 | | | .30 | | |
| | Adjusted R^2 | | .26 | | | .28 | | |
| | F | | 16.107 ($df = 4, p < .001$) | | | 14.188 ($df = 5, p < .001$) | | |
| | | | | | | | | |

literatures (e.g., Cole, Harris, & Bernerth, 2006; Moldovan & Goldenberg, 2004; Oreg et al., 2005). As the findings indicate, domain-specific RTC is a determinant of users' PEOU of digital libraries, and thus the RTC construct improves the explanatory power of a model that includes personal differences and system characteristics used in prior research (Hong et al., 2002). The addition of the RTC construct contributes to our understating of the determinants of PEOU of digital libraries by taking into account a fundamental personality trait that has not been considered thus far in the technology-acceptance literature. Moreover, the present research overcomes one of the common limitations of previous technology-acceptance studies, namely the reliance on retrospective surveys (Venkatesh et al., 2003). Therefore, our findings represent new insight into users' beliefs about the new system's characteristics and ease of use at a point that is critical to users' adoption decisions.

One possible limitation of this study is related to the participants' prior experience: participants who have used a digital library system in the past may develop certain beliefs about them that are different from the beliefs of participants who never used a digital library system (e.g., beliefs about the system's ease of use). This potential concern, however, may not be very relevant in the present study, since participants were first-year undergraduate students, and are therefore not very likely to have much experience with the use of a digital library system.

Future research may focus on RTC and additional factors explaining the behavior and beliefs of digital-library users. In particular, it seems that users' *perceived value of information* (Ahituv, 1989) would be helpful in explaining users' acceptance of a digital library system in conjunction with RTC. Perceived value of information is based on a subjective evaluation performed by the system's users, and can be operationalized in a number of ways (Ahituv). A potential extension of the model presented in the present study may include the relationship between RTC, perceived value of information, PEOU, and PEOU antecedents, as well as the effect of their interaction on the system's acceptance. Such an extension would help to account for cases where factors are operating in opposite directions. For example, high PEOU and low perceived value of information may result in a low (or high) tendency to use a

system. An inclusion of all constructs in an extended model would help to evaluate the effect of each of the independent variables separately.

Given the growth of digital libraries in recent years, it is important for practitioners and researchers to understand what can be done to increase usage and make digital libraries more effective (Thong et al., 2002). Therefore, from a practical perspective, understanding the role of RTC in user acceptance can help designers and implementers of digital libraries create a better fit between users' personal characteristics and the systems' design, look, and feel. For example, to encourage users who are high in RTC to adopt and use a digital library, it may make sense to design new systems such that they are not perceived to embody too much change. The same holds for implementation and users' training: when a new system is introduced, familiar aspects of the system could be highlighted to mitigate users' resistance.

Moreover, in cases where there is a tradeoff between adding new components that involve a lot of changes for the user (e.g., a new interface), or alternatively keeping the familiar system as it is, consideration should be given to the RTC of the systems' users. Those in charge of digital libraries should be cautious when implementing changes to a system whose intended users have high RTC. Alternatively, changes to a digital library system when the user base is high in RTC should be accompanied by additional training and support.

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