Beyond Classical Economics: Exploring the Impact of Social-Psychological Factors on Preference for Speed over Price and Willingness to Pay for a Faster Wireless Service Plan

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***Abstract*—With the rapid adoption of Internet and wireless technology, the demand for a faster and reliable speed has been dramatically increasing. Identifying influential factors in consumers wireless technology adoption and willingness to pay for a faster Internet speed across various settings has been an important and focal interest in wireless communication for both researchers and practitioners. By using both experimental and survey methods, this study empirically tested the impact of social influence and demographics factors on individuals preference for Internet speed over price and willingness to pay for a faster plan. Results of the experiment showed that friends preference for a slower but cheaper Internet significantly decreased peoples own willingness to pay for a faster Internet. Results of path modeling further revealed that perceived usefulness of Internet led to a higher level of preference for speed, which in turn led to a higher level of willingness to pay. Computer self-efficacy had a small and negative relationship with willingness to pay for a faster Internet; people with a liberal political orientation reported stronger willingness to pay for a faster Internet. This study makes contribution to the theoretical and empirical understanding of consumers adoption intention and willingness to pay for a specific wireless service.**

I. Introduction

The Internet and World Wide Web have opened up unlimited space for people to communicate, learn, search information and do business. With the rapid adoption of Internet and wireless technology such as laptops, mobile phones, personal digital assistances (PDAs), third generation (3G) technology and others, the demand for a faster and reliable speed has been dramatically increasing. Although the Internet appears to have much to offer as an instrument of information or business, little is known about the consumers willingness to pay for a specific Internet service, such as faster-speed Internet, and other potential factors that could influence their technology adoption or payment decisions. One of the most common assumptions in examining peoples willingness to pay for a certain service is value maximization based on classic economics approach. Classic economics consider individuals as rational agents who are self-interested and seek to maximize their personal utility [1]. Therefore, cost is one of the assumed factors to influence technology acceptance or willingness to pay, according to these class economics assumptions. In contrast, behavioral economics recognize human beings do not always make rational choices and emphasize the impact of psychological factors on economic decision-making. Yet, the social, psychological or environmental factors are often overlooked or not explicitly assessed in behavioral economics literature. A comprehensive study about social-psychological factors in regards to wireless technology acceptance or willingness to pay for a certain Internet service offers the potential to derive important implications regarding how wireless communication could be developed or marketed more effectively, thus leading to greater consumer acceptance. In sum, the purpose of this study is to: 1) investigate whether friends preference for a faster or slower Internet service plan affects ones choice of Internet service plan and willingness to pay for it, and 2) identify social-psychological and demographic factors influencing peoples choice of Internet service plans and willingness to pay for them. Investigating these two issues will benefit researchers to better understand the social-psychological factors affecting the acceptance of wireless frequency spectrum in a consumer context and willingness to pay for a certain wireless service.

Another purpose of the study is to find deviations from standard economics in the context of wireless communications. There have been many studies on applying economics to analyze wireless communication networks. Essentially they are based on standard economics models (SEMs); i.e., each user/bidder is assumed to be rational and can maximize its concave utility function, which is completely known to itself. Meanwhile the market is complete and can be cleared by the optimal prices. Many excellent studies have proven that the proposed schemes are efficient in the ideal case in which SEMs hold rigorously. However, various studies show that SEMs usually deviate from real life and may generate misleading conclusions. For example, in most studies on network utility maximization (NUM) [30]–[32], a fixed concave utility function is assumed for each user, based on which the pricing mechanism and stability analysis are derived. However, as will seen later, the utility function for wireless spectrum access is usually not concave and is often affected by the decisions of friends (details will be elaborated later). Such a phenomenon has been found by economist D. Kahneman (2002 Nobel Prize in Economic Sciences) in 1979 [27] and led to the Behavioral Economics [28], [29].

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II. Theoretical Background

Classic economics consider individuals as rational agents who are self-interested and tend to make a rational choice [1]. In contrast, behavioral economics recognize people do not always make rational choices; and therefore, focus on the impact of psychological factors on decision-making. The famous prospect theory, a behavioral economic theory, is proposed to explain decision making under risk by assuming people choose the behavior that lead to the highest payoff [2]. According to prospect theory, the value function is adopted over perceived gain or loss relative to a reference point. Although prospect theory offers more explanations on the process of decision-making in comparison with expected utility theory [3], behavioral economics literature either neglects social, psychological or environmental factors or does not explicitly assess these factors. In other words, social or psychological factors are generally not examined separately.

Besides the economics factor (i.e., price), a growing number of scholars have investigated various influential factors of different technology adoptions across different settings [4]. The Technology Acceptance Model (TAM) is considered as one of the most influential and valid models to explain the factors of affecting technology acceptance or information systems across a wide variety of contexts [5]. Derived from the Theory of Reasoned Action (TRA) [6], TAM assumes that behavioral beliefs about usefulness and ease of use are the primary determinants of IT or information system adoption. According to TAM, perceived usefulness (PU) and perceived ease of use (PE) are the two determinants of individuals attitudes toward using a particular technology or system, which in turn impact their intention to use and generate the actual behaviors [5]. For instance, PU and PE were found to be significant variables in affecting behavior intention to use wireless technology [7]. However, the rapidly increasing tendency of Internet use and diverse worldwide e-commerce has led researchers difficult to predict consumers behaviors; therefore, PE and PU in TAM model may not fully explain the Internet uses motive or behaviors [7]. A growing number of recent technology adoption studies; therefore, have proposed alternative factors such as habits, enjoyment, value perceptions, motivation, attitudes toward technology, computer self-efficacy, social influence and demographics are statistically associated with technology acceptance or intention to use technology [7-11]. A recent study indicates that there is a positive relationship between consumers habit and technology use, besides the influence of PU and PE [9]. Another studies report that hedonic motivation, defined as the fun or pleasure derived from using a technology, is found to influence technology acceptance and usage [7] [9][11]. In addition, computer self-efficacy, defined as ones judgment of their capabilities to use computers in different situations [13], has been found to positively influence perceived usefulness and perceived ease of use of world-wide web [14]. In the context of mobile technology, a study demonstrated value perception was a crucial determinant of Mobile Internet adoption and it fully mediated the effects of customers beliefs (i.e., benefit and sacrifice) on adoption intention [8]. Furthermore, the factor of need for uniqueness was found to have direct positive influence on adoption intention and perceived usefulness of technology [7].

The question of how other variables affect PU and PE requires a deeper investigation while examining any new technology acceptance [5]. Indeed, TAM does not account for social influence in technology adoption. A few researchers also stress that TAM is a useful, but need to consider other factors related to human and social change processes [4]. Therefore, this study argues that investigating the factor of social influence such as friends decision will strength TAM and makes contribution to the literature of wireless communication technology adoption. The role of friends decision in wireless communication acceptance of purchase proposed in this study is based on the approaches of social norms and social networks.

Both social norms and networks are powerful determinants of human behavior. Norms are cultural phenomena that prescribe and proscribe individuals behaviors [15]. According to Theory of Reasoned Action [6], subjective norms (i.e., perceived approval of a certain behavior from significant others) are positively related to individuals behavior intention. For example, evidence suggests that peers approval of health behaviors, such as drinking attitudes and alcohol use, are the strongest predictors of alcohol consumption among adolescents and college students [16]. In the context of wireless communication technology, subjective norms are positively related to the adoption intention of mobile data services [7], mobile Internet technology [9] [17], perceived usefulness and ease of use of wireless Internet via mobile technology [18], and mobile payment services [19]. Instead of examining the perceived approval of a certain behavior from peers or significant others, this study focuses on the impact of friends decisions on individuals choice in regards to an Internet service plan, based on social network approach. Social network approach assumes that the structural locations and positions within a network expose individuals to the behaviors of others, leading to a convergence in how they think and behave [20]. Mounting evidences show that young people are more likely to adopt the same behavior if they have friends conducting the same behavior [21]. In the context of technology, information passed through peoples social networks has an impact on their perception of a target technology [22]. In the adoption of wireless mobile communication, scholars suggested a certain number of the members of ones social networks using the same technology influenced ones use of data services of a mobile device [23].

The majority of technology acceptance literatures have considered price value or structure as the one of predictors of technology acceptance or use; little attention has been paid to the factors contributing to willingness to pay. In addition, the nature and implications of individuals choice of a specific Internet plan is not yet understood fully. To the best of our knowledge, no previous research has examined how major variables in TAM affect peoples willingness to pay for a faster Internet plan. This research attempts to help in bridging this gap by investigating friends choices and other social psychological and demographics factors. By integrating the recent

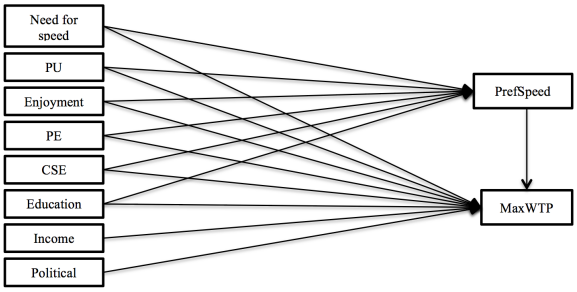

Fig. 1: Proposed Model of Social-psychological and Demographics Factors. Note: Dependent variables are maximum willingness to pay for a faster plan (MaxWTP) and preference for speed over price (PrefSpeed). Independent variables are need for Internet speed (Need for Speed), perceived usefulness of Internet (Usefulness), perceive enjoyment from Internet (Enjoyment), perceived ease of use (Ease), computer self-efficacy (CSE), education level (Education), annual household income (Income), and political orientation (Political). .

findings of technology adoption literature and literature of social norms and networks, this study proposes the following hypotheses: Hypothesis 1: Friends preference for a faster or a cheaper Internet service is more likely to impact ones own decision on the Internet service plan in the same direction. Hypothesis 2: Friends preference for a faster Internet service is more likely to increase ones willingness to pay for a faster Internet service, while friends preference for a cheaper Internet service is more likely to decrease ones own willingness to pay. . Hypothesis 3: Social-psychological factors including perceived usefulness of Internet, perceived ease of use of Internet, enjoyment, and need for a faster speed have a positive impact on individuals preference for a faster Internet service and their willingness to pay for it. Hypothesis 4: Demographic factors including gender, age, education, income and political orientation will influence ones choice on a faster Internet service over price and willingness to pay for that service.

III. Method

A. Participants and Data Collection

This study was conducted through Amazons Mechanical Turk. The Mechanical Turk web site is a forum that Amazon has established to let companies and researchers pay people a small amount of money in order to participate studies or survey. Mechanical Turk has been gaining much popularity among social scientists as a useful data collection tool [24]. Our sample pool was drawn from this site with a total of 400 U.S. residents. However, only 280 participants understood every question and provide valid answers, therefore, 280 cases were used for the final analysis. Among these subjects, 50.89% were males, 47.69% were females, and the rest preferred not to answer. Average age was 33.93 (SD = 12.76) ranging from 18 to 72. 76.51% of participants have received at least some college education and 43.06% has an annual household income higher than 50,000 dollars. 56% participants reported a liberal or strong liberal political orientation, while 14.2% reported a conservative or strong conservative orientation.

B. Experimental Design

This study contains two parts including a between-subject experiment and a survey. For the experiment, we designed three conditions to determine whether friends preference (favor or against) on a faster but expensive Internet plan would influence ones choice for the same plan, as well as how much money he/she is willing to pay for it. All participants were instructed to imagine themselves as currently paying $2 per day for a 12Mbps Internet service plan, which served as a reference point, and that they could choose to upgrade or downgrade to a different plan after reading one scenario. Participants were randomly assigned to one of the three manipulated conditions. In condition one, participants read a scenario indicating most of their friends were thinking about upgrading to a faster plan. In condition two, participants read the scenario indicating most of their friends were thinking about downgrading to a cheaper plan. Two versions of the message contained the same amount of texts and were of equal difficulty in terms of language used. In condition three, participants read nothing, which serviced as a control group. After the manipulation, all participants were provided with six Internet speed plans with different rates and asked how much money they would be willing to pay for each of them. For example, two different kinds of plans were described as: Plan I: 18Mbps - you could download a full-length HD movie (1GB size) in 1.5 hours. Would you consider this plan? If so, how much dollars per day would you pay at maximum for the service plan? and Plan II: 6Mbps - you could download a full-length HD movie (1GB size) in 4 hours. Would you consider this plan? If so, how much dollars per day would you pay at maximum for the service plan? Among the six plans, three of them were faster than the reference point, that is, 18Mbps, 24Mbps and 32Mbps; the other three were slower than the reference point; that is, 1Mbps, 3Mbps, and 6Mbps. The measures of two dependent variables include the maximum amount of money a person was willing to pay for a faster data plan (regardless it was for the 18Mbps, 24Mbps, or 32Mbps plan); and the degree to which a person preferred a faster speed over a low price. For the measure of the preference of speed over price, participants were asked to use a sliding bar from 0 to 100 to rate their preferences, with 50 indicating an equal preference for speed and price and a higher number than 50 indicating participants' stronger preference for speed.

C. Survey Design

In order to determine the relationships among social-psychological and demographics factors, individuals decision-making for faster Internet service and willingness to pay, we have designed a series of survey questions asking participants to report their need for Internet speed, computer self-efficacy, enjoyment, perceived usefulness (PU), and perceived ease of use (PE) about Internet use, as well as demographic information. All the scales were adapted from previous research and measured using a five-point Likert scale, with the anchors

being strongly disagree and strongly agree. Specific measures are discussed as follows: Need for Speed was measured by the frequency of engaging in specific online activities. Participants were first asked to answer, How long do you use Internet per day on average? and then to rate the frequency of engaging in each of the following online activities including amusement (e.g. watching movies, YouTube videos), banking (e.g., managing bank accounts, paying bills), chatting and messaging (i.e., online telephoning and video chatting), conducting business or work-related tasks, downloading music, TV episodes, movies and so on, training and education, emailing, gaming, general browsing (e.g., news reading), shopping, and social networking (e.g. Facebook, twitter, pinterest). Some of these online activities have a lower level of requirement for high Internet speed while others require a higher speed, such as watching movies, downloading, and gaming. Participants maximum ratings on high speed-required activities were used as a measure of actual need for Internet speed. PU and PE were measured by asking participants to rate on seven statements. Four questions were used to measure PU including the statements; I find Internet useful in my daily life, using Internet helps me perform many things more conveniently, using Internet helps me accomplish things more quickly, and Using internet increases my productivity. In addition, three questions were used to measure PU including the statements; I find Internet easy to use, Learning Internet is easy for me, It is easy for me to become skillful at using Internet. Cronbach's alpha for PU and PE were 0.77 and 0.86 respectively, indicating good levels of internal consistency reliability. All the questions in PU and PE were summed and averaged to compute two different variables. Computer self-efficacy was measured using the standard scale developed by Compeau and Higgins [25]. Participants rated their confidences on a 0-10 Likert scale about using imaginary new software under 10 different circumstances. Sample questions included, if there was no one around to tell me what to do and if I had never used a package like it before. Each participants confidence ratings across 10 circumstances were averaged to indicate the level of ones willingness to accept new technologies, with a higher number indicating a stronger level of willingness. Demographic factors. Demographic questions include gender, age, education, occupation, income, and political orientation. For political orientation, participants were asked to indicate their perceived level of liberal or conservative in political view based on a five-point scale.

IV. Results

A. Impact of Friends' Preferences

To test Hypothesis 1, a between-subject Analysis of Variance (ANOVA) was conducted on maximum willingness to pay for a faster plan (MaxWTP) with friends preferences of Internet plans as the independent variable. Results of the model showed that friends preference had a marginally significant impact, F (2, 276) = 2.81, p = .062, suggesting that there might be at least one group differing from another. A T- test was further conducted to compare each pair of groups. Results indicated that people in Condition 2 where friends preferred the plans of lower price over faster speed were more likely to pay significantly less for a faster plan than people in Condition 1 where their friends preferred a faster plan, t (170) = 2.33, p = .021, and people in the control group, t (179) = 2.13, p = .035. Condition 1, however, did not differ from the control group. Table 1 shows the average mean and standard deviations (S.D.) for two dependent variables (i.e., MaxWTP and preference for speed over price (PrefSpeed) across three conditions.

Condition	Variable	*N*	*Mean*	*S.D.*
1 (friends favoring faster speed)	MaxWTP	98	58.28	21.16
	PrefSpeed	97	4.10	2.11
2 (friends favoring lower price)	MaxWTP	75	51.72	18.84
	PrefSpeed	75	3.40	1.74
3 (control group)	MaxWTP	107	55.77	21.34
	PrefSpeed	107	4.04	2.30

Fig. 2: PMean and Standard Deviations (S.D.) of MaxWTP and PrefSpeed across three Conditions.

To test Hypothesis 2, another ANOVA was conducted on PrefSpeed with friends preference of Internet plans as the independent variable. Result of the model failed to suggest any significant differences among the three conditions F (2, 277) = 2.15, p = 0.118. However, T- test showed that people in Condition 1, where their friends favored faster speed plans, reported a stronger preference for faster speed than people in Condition 2 where their friends favored lower price plans, t (171) = 2.12, p = 0.036. Neither of means in condition 2 and 3; however, differed from that of the control condition. We also tested gender difference in every condition, and results showed that women were more susceptible to friends preference of speed over price than men. That is, women were more likely to pay significantly more money (M = 4.66, SD = 2.31) than men (M = 3.65, SD = 1.78) for a faster plan when knowing that their friends were thinking about upgrading to a faster plan, t (94) = 2.42, p = 0.017.

B. Results of Social-psychological Factors

To test Hypothesis 3 and 4, path analyses were used to model several regression relationships simultaneously. This study used Mplus (6.2) [26] to analyze the data by using the sample from the control group condition where were not influenced by manipulated social influence of friends preference. The model was analyzed by entering the PE, PU, enjoyment, computer self-efficacy, need for speed and demographics as the independent variables whereas PrefSpeed and MaxWTP as the dependent variables. The measures used to assess model fit include Chi-square (χ^2), degree of freedom (df), $\chi 2/df$ ratio, Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Residual (RMSR), and Root Mean Square Error of Approximation (RMSEA). The Overall fit of the path model yielded the following statistics with a great fit: χ^2 (2) = 1.96, p = 0.38, CFI = 1.000, TLI = 1.014, RMSEA = 0.000, SRMR = 0.015.

Results showed that there were five significant paths in the model (See Figure 2). First, PrefSpeed was shown to

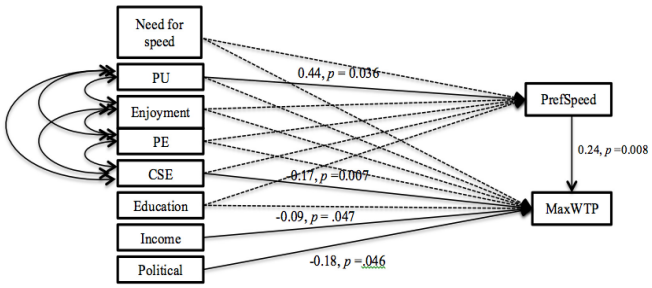

Fig. 3: Significant Paths of the Proposed Model (in solid lines) Note: $*p < .05$; $**p < .01$; $***p < .001$. .

be positively related to MaxWTP (B = 0.24, p = 0.008), that is, given a one S.D. increased in PrefSpeed, there was 0.24 S.D. increased in MaxWTP. Second, PU was the only significant predictor of PrefSpeed (B = 0.44, p = 0.36) among all the predictors, with 0.44 S.D. increased in PrefSpeed given one standard-deviation increased in PE with all other independent variables held constant. Third, computer self-efficacy was negatively associated with MaxWTP (B = - 0.17, p = 0.007), meaning that one S.D. increased in computer self-efficacy would lead to 0.17 S.D. decreased in MaxWTP. Among the demographics factors, income was also found to be negatively related to MaxWTP (B = - 0.09, p = 0.007), but the relationship was rather small. In addition, political orientation was negatively associated with MaxWTP (B = - 0.18, p = 0.046) with the result of one S.D. increased in liberal orientation would lead to 0.18 S.D. increased in willingness to pay for a faster Internet service.

Despite the fact that several proposed factors were significantly related to MaxWTP and PrefSpeed, the proposed model indicates some limitations. For example, some independent variables were highly correlated to each other, thus might lead to the insignificant paths. Specifically, PU correlated with PE at 0.53, and with enjoyment at 0.66. PE correlated with enjoyment at 0.57.

C. Utility Functions

Using the survey from the 281 participants, the utility function, defined as the maximum tolerable cost given the price, is obtained. Several typical curves are shown in Fig. 4. It has been observed that, when the data rate is higher than the current reference point (12Mbps at 2 dollars), the function tends to be concave; while the data rate is lower than the current reference point, the function tends to be convex. This coincides the observations in behavioral economics and contradicts the standard assumption of concave utility function in economics[1]. In Fig. 5, the average of utility functions of the participants groups with positive, negative and null social information are plotted.

The relative increases of the utility function at the six prices brought by the positive social information versus the negative

[1]Actually,only the utility functions of 3 users are completely concave.

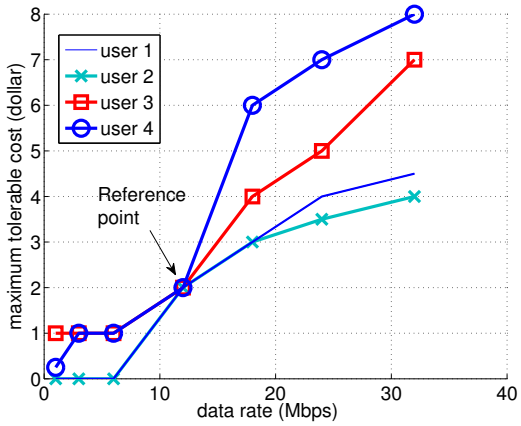

Fig. 4: Several typical utility functions. .

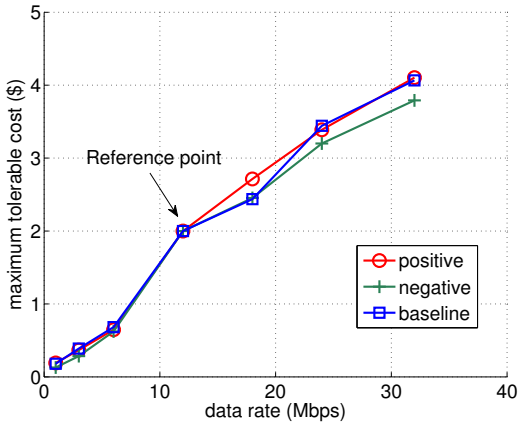

Fig. 5: Average utility functions subject to different social norms .

social information are 48%, 29%, 4%, 11%, 6% and 8%, respectively. The statistical significance of the impact of social information has been verified using the t-test. In summary, the survey demonstrates the insufficiency of standard economics analysis on utilities in wireless communications, where the concavity assumption is no longer valid and the social impact on the value evaluation has not been taken into account.

V. Conclusions

Findings of this study suggest friends preference or choices has an impact on individuals choices of a specific Internet plan and willingness to pay for that service. Although Hypothesis 1 and 2 were only partially supported, our results showed that that friends preference for a lower price influenced ones decision not to pay for a faster but expensive plan, however, friends preference for a faster speed failed to influence ones decision. Among all the proposed social-psychological factors, PE was a strong predictor and increased the level of PrefSpeed. Contradictory to our prediction, people who had a high level of computer self-efficacy were less likely to pay for a faster Internet speed. It would be interesting to test whether this finding was an artifact caused by our particular reference

point in the future study. In terms of demographic factors, people who identified as liberal political orientation were more willing to pay for a faster Internet service. Income level, however, was negatively related to willingness to pay. This study has make contributions to the field of wireless technology adoption or acceptance. At the metrology level, we used both experimental and survey designs to studies to test our hypotheses and provided a solid analysis. The majorities of studies in technology adoption were survey-based only. We believe the findings are crucial because they demonstrate the important role of social influence and social-psychological factors in investigating technology acceptance and willingness to pay, which have not been paid much attention by traditional classic economics and engineering research. Our research also makes contribution to TAM by investigating various factors. One of the limitations in this study mainly comes from the online experiments by using vignettes (i.e., imaginary scenarios). It may be difficult for some people to imagine being in a particular situation. In addition, some of our participants did not understand the reference point. Finally, there might be a gap between self-report preferences and actual behavior happened in real world. Future studies should be use controlled field experiments to examine to what extent social psychological factors influence actual behaviors in wireless communication technology. From the social survey, we also obtained typical utility functions for wireless spectrum access, which implies that the utility functions are not strictly concave.

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