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What do we know about mobile Internet adopters?A cluster analysis

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Abstract

Despite the increasing importance of wireless Internet use via Web enabled mobile telephony, the relationship between consumers' attitude and their demographic characteristics have been only cursorily examined. The objective of our study was to fill this gap, by applying a two step cluster analysis in profiling mobile Internet adopters in Japan. The findings suggest that four clusters exist; they exhibit distinct profile patterns. Paradoxical results were found within one, affluent single youth, which was further divided into two clusters: freelance, highly educated professionals had the most negative perception of mobile Internet adoption, whereas clerical office workers had the most positive perception. Married housewives and company executives also exhibited a positive attitude toward mobile Internet usage.

Keywords: Mobile; Diffusion; Innovation; Internet; i Mode; Japan; Uses and gratifications

1. Introduction

In world markets, the rapid adoption of Web-enabled mobile handsets has become increasingly important to IS professionals. A recent survey in 13 countries revealed an increase in usage of 145%, reaching 79 million users in 2003, while the number of global mobile Internet adopters has been predicted to reach nearly 600 million by 2008 [19,35]. A pessimistic forecast estimated that, by the year 2005, the number of Internet-connected mobile phones would exceed the number of Internet-connected PCs [44]. Such dramatic convergence of the Internet and mobile telephony may be attributed, in particular, to activity in Asian and Scandinavian countries, where penetration growth has been meteoric. A recent survey indicated that roughly 70 million people in Japan (55% of the population) have signed up for Internet access from their cellular phones, compared with 12% of the population in the USA [13,15]. In fact, the Japanese see cell phones or *Keitai* as devices for surfing the Internet while Americans use their laptops.

Much of this success can be traced to February 1999, when NTT DoCoMo, Japan's leading mobile operator, launched the i-mode service. This is 'a mobile

phone service offering continuous, always-on Internet access based on packet-switching technology' [6]. Through a handset, users can access a micro-browser that offers services such as e-mail, data search, instant messaging, Internet, and *i-menu*. E-mail is considered the most popular *killer app*, and 71% of i-mode users receive an e-mail newsletter [29,38]. The i-menu acts as a mobile portal resulting in approximately 4100 official and 50,000 unofficial sites offering diverse additional functions [32].

One of the unusual features of i-mode is the way it develops i-mode content. Instead of purchasing it, DoCoMo allows 'designated third parties to provide fee-based content and services with collection through the monthly phone bill'. By October 2003, more than 40 million subscribers to 2G and 3G i-mode Internet services existed. The key to understanding this growth lies in the profiles of mobile consumer segments but little effort has addressed the fundamental question: what are the attitudinal and demographic characteristics of mobile Internet adopters?

The purpose of our study was to fill this gap, by conducting a two-step cluster analysis to identify specific segments of mobile Internet adopters in Japan. Our method overcomes the limitations of traditional cluster analysis by: (1) considering both continuous and categorical variables and (2) automatically determining the number of clusters or segments on the basis of objective statistical criteria.

2. Significance of the study

This study contributes to electronic commerce literature in two ways. First, research on mobile Internet adopters has primarily focused on the area of direct marketing; user profiles have rarely been considered. The majority of the studies result from sporadic industry reports that leave an important question unanswered: in developing effective business-to-consumer m-commerce strategies, how do information managers identify mobile Internet adopters? And: what kind of demographic and psychographic segments do they have? An effort to classify mobile Internet adopters based on specific attributes may therefore help in driving the development and execution of customer strategy and targeting of customers.

Second, despite obvious cultural differences, an empirical investigation of consumers can serve as a useful case study for other markets. DoCoMo's i-mode, for example, has expanded to European countries; the adopters include E-Plus (Germany), KPN Mobile (Netherlands), BASE (Belgium), Bouygues Telecom (France), Telefonica Moviles (Spain), Wind (Italy), and COSMOTE (Greece), and total subscribers reached 1.5 million by the end of 2003, from 270,000 at the end of 2002 [1]. The software platform and its content have been converted into added value resulting from the solution and partner network, possibly providing wider implications [28]. Therefore, it is important to establish a theoretical basis of the attitudes and demographics of mobile Internet adopters.

3. Mobile content creation in the m-commerce value chain

A chain of value-adding activities in mobile-commerce involves two global perspectives: content and infrastructure-and-services [5]. The current moves by global mobile players, however, place more strategic emphasis on content, the value chain of content aggregation, its management, and access [25]. DoCoMo's i-mode, for example, is a 'semi-walled garden' controlled by its packet network and server system; in this many different contents may be structured into official (approved) and unofficial (non-approved) providers (Fig. 1). However, only official providers can charge for content through DoCoMo's subscription billing system, which offers multiple incentives for active content creation.

The mobile portals play a key role in adding value to mobile market-making [5]. For instance, when users select i-mode, they are presented with i-menu with links to personal information management applications, offering users a *one-stop shop solution*. The increasing sophistication of mobile handsets has accommodated diverse *killer apps*, such as built-in GPS, music downloads, videos, e-coupons for discounts, bill payment, and even karaoke machines. Strategically, this portal imposes no additional infrastructure costs, because the content creation can be arranged with a number of third-party content providers and aggregators. As a result, in 2004 DoCoMo's group net profits more than tripled to 650 billion yen [2] and its

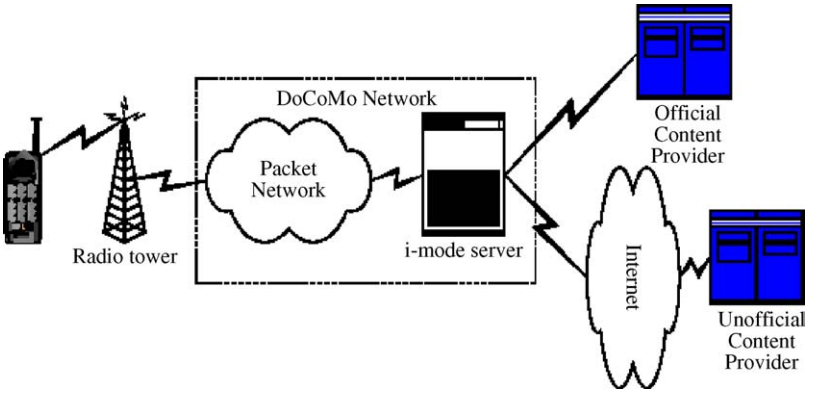


Fig. 1. Functions of i mode Internet service. *Source*: Reprinted by permission of Ref. [28].

Table 1
Mobile Internet services in Japan

	i Mode	Vodafone live	EZweb
Operator group	NTT DoCoMo	Vodafone	Au (KDDI)
Market share	60.5%	19.5%	20.1%
Number of subscribers[a]	41.32	12.95	14.36
Markup language	cHTML	MML	HDML
3G/2.5G network[b]	W cdma	W cdma	Cdma2000 1X
Maximum capacity (packet)[b]	384 kbps	384 kbps	144 kbps
Number of official sites[c]	4100	650	>2000
Charge[d]	1000 yen monthly charge + 0.1 yen per packet	300 yen monthly charge + 0.3 yen per packet	300 yen monthly charge + 0.2 yen per packet

[a] In million [43].
[b] Ref. [41].
[c] Refs. [17,32].
[d] Refs. [3,31,46].

competitors, Vodafone and au (KDDI), implemented similar mobile Internet services, albeit using different underlying technologies [17] (Table 1).

4. Profiling mobile Internet adopters

In pursuing this study, it was necessary to establish a conceptual framework for assessing the structure of the mobile Internet market. In general, markets consist of a number of segments, each of which is made up of natural groupings of customers [14]. Consumers can be split into different segments or clusters, within which customers have similar characteristics and needs [27]. The combined benefits were sought by adopting a two-step cluster analysis.

4.1. Demographic profiling

Demographic profiling is the process of splitting the market by considering personal similarities and differences, such as gender, age, marital status, occupation, monthly allowance, and household structure. Such descriptive attributes have been used in most industry surveys.

Earlier industry reports have indicated that mobile Internet penetration was highest among young affluent males [42]. Most of them (83%) were found to use the mobile Internet for personal purposes, but a substantial portion (49%) also used it for work. WAP adopters in Taiwan were predominantly young single males (21 40 years old) with middle income [18]. A recent US industry report also indicated that a typical

user was male, between 18 and 34 years old, with a household income of US$ 60,000 or more. Such findings suggest that the likelihood of adopting mobile IT innovations is dependent on age and income, while the effect of gender on mobile Internet service adoption remains uncertain. For example, a survey of mobile text messaging by 500 British young adults found hardly any differences due to age or gender [7]. In addition, a survey of mobile banking adoption in South Africa found that the majority (67%) of the respondents were 'young, educated groups, either employed or studying or both', with the gender distribution approximately equal [9].

4.2. Attitudinal profiling

While many industry surveys have focused on descriptive characteristics, little diagnostic information has been provided on mobile Internet adopters, where similar demographic data may be differentiated by the adopters' psychological motives. We therefore attempted to uncover profiles on the basis of: (1) the uses and gratifications of adopters with the new media and (2) the diffusion of the mobile Internet as an innovation.

The *uses and gratifications theory* is axiomatic; it argues that psychological needs shape an audiences' adoption of the media [23]. This theory is primarily grounded on three basic tenets: media adopters are goal-directed, active media-users, and aware of their needs. Because the mobile Internet service has been characterized as being highly personal, interactive, and immediate [10], important attributes can be found by profiling individuals according to the degree to which they spontaneously perceive the medium to be irritating, informative, or entertaining. These have been identified as principal motivations in wired Internet service adoption [11,22,24], while prior research on the mobile Internet has made similar suggestions [4,21].

Rogers [36] defines the diffusion as 'the process by which an innovation is communicated through certain channels over time among the members of a social system'. Therefore, it is a communication of new ideas, in which 'participants create and share information with one another in order to reach a mutual understanding'. Thus, the mobile Internet seems to satisfy the five principal characteristics of innovation: (1) relative advantage over the idea it supersedes; (2) compatibility with existing technology; (3) perceived complexity of its understanding and use; (4) trialability; (5) observability to others. These variables collectively result in user attitude toward the mobile Internet, which in turn affects consumers' behavioral intent to use it.

Furthermore, prior research on Japanese i-mode adoption suggested that the credibility of a new communication channel was key to the choice of access. This was important, because more than 20% of Japanese mobile Internet adopters accessed news and city guides, which often acted as a trusted information source in their daily lives. Also, with logo branding and sponsorship campaigns increasingly popular in mobile sites, users may also have wanted to be sure of the trustworthiness of such paid-publicity. By choosing the i-menu, users could access a content-based platform, *Tokusuru Menu* (menu to your advantage, in Japanese), which featured text banner ads from sponsoring companies. By clicking, consumers could browse further detailed information pages that offered discounts, coupons, free-samples, sweepstakes, and ring-tone downloads, etc. Therefore, in forming basic attitudes toward and intention to access the mobile Internet, individuals may have been reminded of the underlying information credibility and trustworthiness.

5. Methodology

5.1. The questionnaire

Our study was part of an omnibus research project conducted by an advertising research foundation in Tokyo. The survey instrument included face, common, and specific questions. The *face questions* covered general demographic information, such as gender, occupation, marital status, monthly allowance, and hours spent outside home. The *common questions* were related to general perceptions of media selection, leisure activity, consumption attitude, etc. Finally, the *specific questions* addressed attitudinal dimensions with respect to i-mode platforms, including content and source credibility, informativeness, entertainment, irritation, general liking, and willingness to access.

It seemed reasonable to assume that usage of e-mail messaging and access to mobile portals were two key

indicators of mobile Internet adopters. Therefore, photographic images of i-menu portal sites were inserted in the questionnaire in asking respondents for their general opinions on the use of such services. With regard to e-mail usage, the questionnaire included a filtering question: did respondents use e-mail messaging via mobile telephony?

5.2. Sample

The sample involved stratified random sampling according to age and gender distribution. The population was based on the Citizens Registry Book of the Tokyo Metropolitan District. Questionnaires were distributed to 1623 residents in the greater Tokyo area. A professional marketing organization was employed for this task, and researchers visited each respondent to leave the questionnaire. A total of 786 responses were collected in the next month, giving an effective response rate of 48.4%. However, only 612 responses were included in the data analysis: those who regularly used the e-mail message service via the mobile phone.

6. Statistical treatment

6.1. The two-step cluster analysis

Traditionally, cluster analysis has been used for empirical classification of objects [16]. It is an exploratory technique that has been widely applied in diverse disciplines for its partitioning ability; e.g., Bhatnager and Ghose [8] applied a latent class modeling approach to segment Web shoppers based on demographics and benefit sought while Jih and Lee [20] attempted to segment cellular phone users according to their retail shopping motives. Thus, this technique was deemed appropriate in forming groups according to the similarity of their demographic and attitudinal variables.

Our study used a statistical program, TwoStep Cluster in SPSS 12.0; this had been suggested as appropriate in clustering large data sets with mixed attributes [30]. The method is based on a distance measure that enables data with both continuous and categorical attributes to be clustered. This is derived from a probabilistic model in which the distance between two clusters is equivalent to the decrease in log-likelihood function as a result of merging [12].

In the first step, original cases are grouped into *preclusters* that are then used in place of the raw data in the hierarchical clustering. Based upon its similarity to existing preclusters, each successive case is added to form a new precluster, using a likelihood distance measure as the similarity criterion. Cases are assigned to the precluster that maximizes a log-likelihood function. In the second step, the preclusters are grouped using the standard agglomerative clustering algorithm, producing a range of solutions, which is then reduced to the best number of clusters on the basis of Schwarz's Bayesian inference criterion (BIC), which is known as one of the most useful and objective selection criteria, because it essentially avoids the arbitrariness in traditional clustering techniques. In addition, both background noise and outliers can be identified and screened out.

6.2. Categorical and continuous variables

The categorical and continuous variables are shown in Tables 2 and 3, respectively. The categorical variables involve gender, age, marital status, occupation, monthly allowance, and household structure. Monthly allowance was chosen over monthly income, on the assumption that the level of mobile usage expenditure is a function of disposable allowance rather than of total income. Each variable was assessed on a categorical scale with no multiple responses allowed. The continuous variables were associated with general perceptions of the mobile platform: content credibility, source credibility, informativeness, entertainment, irritation, general liking, and willingness to access. Each measure consisted of a multiple-item scale, as indicated in Table 3.

To ensure the adequacy of the selected variables, two preliminary analyses were conducted in an attempt to identify significant differences between mobile e-mail users and non-users. This was needed because, if there were no significant differences between the two groups, then profiling made little sense. First, the Pearson chi-square test was performed for each of the categorical variables across the two groups. The expected values in each cell were greater than 1 and most cells had expected values greater than 5. Significant differences were detected at $P < 0.001$ for all variables between e-mail users and non-users. Second, a MANOVA was conducted with type of use or non-use as independent

Table 2
Categorical variables used for the cluster analysis

Variables	Categories
Gender	(1) Male; (2) female
Age (years)	(1) 15 19; (2) 20 29; (3) 30 39; (4) 40 49; (5) 50 59; (6) 60 65
Marital status	(1) Married; (2) single
Occupation	(1) Executive; (2) managerial; (3) clerical; (4) administrative staff; (5) self employed; (6) freelance professional; (7) part time worker; (8) housewife; (9) student; (10) unemployed; (11) others
Monthly allowance (yen)	(1) <10,000; (2) 10,000 19,999; (3) 20,000 29,999; (4) 30,000 49,999; (5) 50,000 69,999; (6) 70,000 99,999; (7) 100,000 149,999; (8) >150,000; (9) unknown
Household structure	(1) Single; (2) married couple; (3) married couple and children; (4) extended family; (5) others

100 JPY ≈ US$ 0.942 ≈ 0.744 EUR.

variable and all continuous variables as dependent variables. Using Wilks' criterion, the continuous variables were significantly affected by e-mail use or non-use, $F(6, 721) = 2.45$, $P < 0.05$.

6.3. Test of assumptions, reliability, and validity

Before starting the cluster analysis, the missing values were replaced with their means by using SPSS 12.0; this was because the missing values seriously distorted the multivariate analysis results. According to the recommendations of Hair et al., the following were examined: (1) the representativeness of the sample and (2) the absence of multicollinearity. First, the sample was considered to be representative, given that our study employed a sufficiently large random sampling procedure, which meant that the results were generalizable to the population of interest. Second, the level of multicollinearity was examined through the tolerance value. The tolerance was found to be within an acceptable range, with all scores between 0.70 and 0.96, indicating low collinearity among variables.

Next, the specific assumptions of the two-step clustering algorithm were assessed. First, the independence of the respondents was ensured by the random sampling plan. Second, to assess the normality of each continuous variable, both skewness and kurtosis tests were determined: in neither test did any of the calculated z-values exceed a critical value ± 1.96, indicating the normality of the distribution at $P < 0.05$. Finally, because our data were not sequential in nature, the multinomial distribution was assumed for each categorical variable. The literature suggests, however, that the two-step clustering algorithm behaves robustly even if this assumption was not met.

The overall construct validity and reliability of all the multiple-item measures (i.e., content credibility, source credibility, informativeness, entertainment, irritation, general liking, and willingness to access) were assessed using maximum-likelihood confirmatory factor analysis using the covariance-based program, AMOS 5.0. First, convergent validity was supported by all the items loadings on respective constructs being statistically significant. Second, all composite reliability estimates exceeded 0.97, while the amount of variance extracted by each construct ranged between 0.64 and 0.90. Third, despite the significance of the chi-square value ($\chi^2 = 442.4$, $P < 0.001$), more pragmatic

Table 3
Continuous variables used for the cluster analysis

Variables	Items	Alpha	Composite reliability	Variance extracted	Tolerance
Content credibility	3	0.93	0.99	0.77	0.79
Source credibility	2	0.95	0.98	0.90	0.78
Informativeness	3	0.93	0.99	0.83	0.70
Entertainment	3	0.93	0.99	0.83	0.72
Irritation	3	0.84	0.97	0.64	0.94
General liking	4	0.93	0.99	0.74	0.88
Willingness to access	2	0.92	0.97	0.84	0.96

Note: All measures were assessed on a 7 point semantic differential scale from 1 (strongly disagree) to 7 (strongly agree).

indices indicate a good fit for the model: goodness-of-fit index (GFI) = 0.93, comparative fit index (CFI) = 0.98, and a root mean square error of approximation (RMSEA) = 0.058. Collectively, these tests indicated that the measures of continuous variables were reliable and valid reflectors of intended constructs.

7. Results

The auto-clustering algorithm indicated that a four-cluster solution was the best model, because it minimized the BIC value and the change in them between adjacent numbers of clusters (Table 4). In addition, the multidimensional map, as shown in Fig. 2, indicated the clear separation of the four clusters.

The resulting clusters 1, 2, 3, and 4 contained 147, 135, 152, and 178 cases, which corresponded to 24.0, 22.1, 24.8, and 29.1%, respectively.

7.1. Demographic profiling

Tables 5 and 6 summarize the frequency distributions for the categorical variables within and across clusters, respectively. Cluster 1 consisted mainly of younger respondents who were in their 20s or 30s, and in three groups of occupations: (1) clerical and administrative, (2) freelance professionals, and (3) other or unemployed. In the first two groups, the monthly allowance was relatively high and more than half of those who could afford expenses of more than 100,000 yen belonged to this cluster. The proportion of male respondents was substantially greater than that of female respondents. In terms of household structure, they were primarily unmarried in single households; however, a relatively large proportion of *others*, which may have included respondents who still live with their parents, constituted this cluster. Similarly, cluster 2 was characterized by a majority of teenage students living alone or with parents. Also, clerical, administrative, or part-time job segments represented an important proportion of this cluster. The majority were singles in their 20s, whose monthly allowance was relatively high. In fact, this cluster occupied the second largest proportion of those with a monthly allowance more than 100,000 yen.

All married women were part of cluster 3 and their monthly allowance was relatively lower than that of other groups. Also, more than half of the part-time workers were in this cluster. They were primarily in their 30 50s. In contrast, cluster 4 consisted of almost all married men who were corporate executives, managerial, or self-employed. This cluster contained most of those whose monthly allowance was between 30,000 and 99,999 yen.

Table 4
Results of auto clustering

Number of clusters	BIC	BIC change[a]	Ratio of BIC changes[b]	Ratio of distance measures[c]
1	3846.2			
2	3517.9	−328.3	1.00	1.49
3	3372.7	−145.2	0.44	1.33
4	3319.1	−53.6	0.16	1.83
5	3392.4	73.3	−0.22	1.01
6	3466.6	74.1	−0.23	1.23
7	3569.1	102.5	−0.31	1.26
8	3697.1	128.1	−0.39	1.15
9	3837.9	140.8	−0.43	1.02
10	3980.1	142.1	−0.43	1.29

[a] The changes are from the previous number of clusters in the table.
[b] The ratios of changes are relative to the change for the two cluster solution.
[c] The ratios of distance measures are based on the current number of clusters against the previous number of clusters.

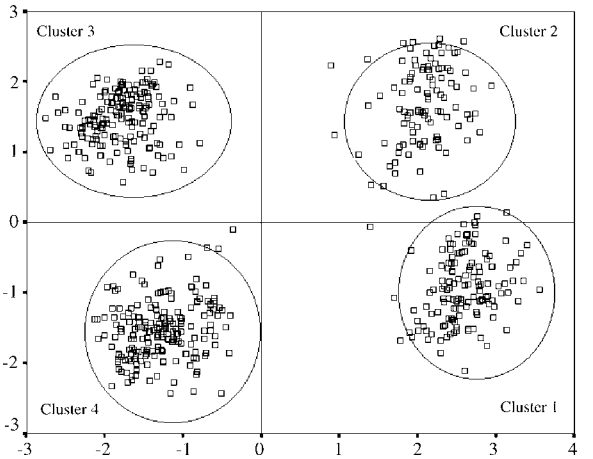


Fig. 2. Multidimensional map of the four cluster solution.

7.2. Attitudinal profiling

Fig. 3 shows the mean values of seven continuous variables for each cluster. Clearly, cluster 2 showed the

Table 5
Composition of demographic profiles within clusters (n 612)

Characteristics	Total	Cluster 1 (n 147)	Cluster 2 (n 135)	Cluster 3 (n 152)	Cluster 4 (n 178)
Gender					
Male	55.1	66.0	50.4	0.0	96.6
Female	44.9	34.0	49.6	100.0	3.4
Age (years)					
<20	5.4	5.4	17.8	0.0	0.6
20 29	27.9	49.0	61.5	9.2	1.1
30 39	27.0	29.3	14.1	35.5	27.5
40 49	17.8	9.5	2.2	28.3	27.5
50 59	16.8	3.4	4.4	21.1	33.7
60 65	5.1	3.4	0.0	5.9	9.6
Marital status					
Married	60.8	32.7	1.5	100.0	95.5
Single	39.2	67.3	98.5	0.0	4.5
Occupational category					
Executive	3.8	2.7	3.0	2.0	6.7
Managerial	7.5	3.4	0.0	0.0	23.0
Clerical	14.9	24.5	19.3	3.3	13.5
Administrative staff	14.2	19.0	15.6	0.7	20.8
Self employed	8.2	6.1	1.5	2.0	20.2
Freelance professional	3.6	7.5	0.7	0.0	5.6
Part time worker	15.8	11.6	19.3	34.2	1.1
Housewife	13.9	0.0	0.0	55.9	0.0
Student	9.8	10.9	31.9	0.0	0.6
Unemployed	2.1	2.7	3.0	0.0	2.8
Others	6.2	11.6	5.9	2.0	5.6
Monthly allowance (yen)[a]					
<10,000	10.8	2.0	9.6	28.3	3.9
10,000 19,999	12.3	6.1	12.6	23.0	7.9
20,000 29,999	16.7	12.9	15.6	21.1	16.9
30,000 49,999	27.1	30.6	30.4	13.2	33.7
50,000 69,999	14.2	18.4	17.8	5.3	15.7
70,000 99,999	6.9	10.9	3.0	0.7	11.8
100,000 149,999	3.4	8.2	5.2	0.0	1.1
<150,000	1.6	4.1	2.2	0.7	0.0
Unknown	7.0	6.8	3.7	7.9	9.0
Household structure					
Single	6.9	12.2	13.3	1.3	2.2
Married couple	10.3	12.2	1.5	13.2	12.9
Married with children	59.3	46.3	54.8	71.7	62.9
Extended family	12.7	15.6	8.1	9.9	16.3
Others	10.8	13.6	22.2	3.9	5.6

Note: The numbers indicate percentages that vertically sum to 100%.
[a] 100 JPY ≈ US$ 0.942 ≈ 0.744 EUR.

most positive attitudes toward credibility, informativeness, and entertainment. In contrast, cluster 1 showed the most negative attitudes toward the mobile platform. Thus, within the same youth groups, there was a clear separation in attitudinal and behavioral intentions. It should be noted that, while a two-step cluster analysis clearly separated four groups, the seven continuous variables seemed to be significantly correlated. Therefore, it seemed reasonable to infer that the more positive the respondents' perceptions of

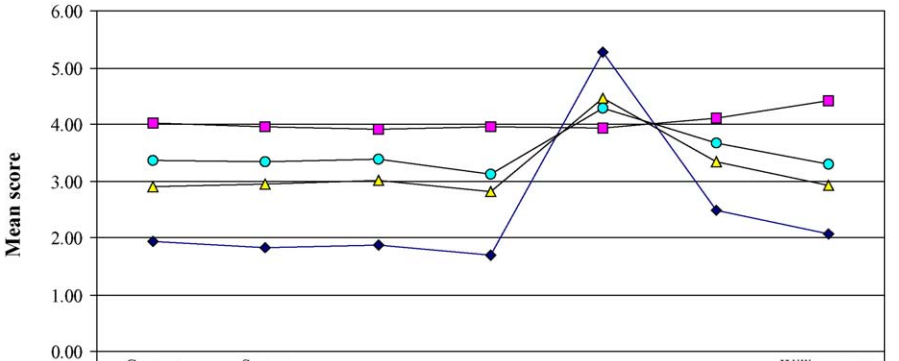
Table 6
Composition of demographic profiles across clusters (n 612)

Characteristics	Cluster 1 (n 147)	Cluster 2 (n 135)	Cluster 3 (n 152)	Cluster 4 (n 178)	χ^2	
Total	24.0	22.1	24.8	29.1	χ^2 6.4, d.f. 3	P 0.09
Gender					χ^2 318.8, d.f. 3	***
Male	28.8	20.2	0.0	51.0		
Female	18.2	24.4	55.3	2.2		
Age (years)					χ^2 327.2, d.f. 15	***
<20	24.2	72.7	0.0	3.0		
20 29	42.1	48.5	8.2	1.2		
30 39	26.1	11.5	32.7	29.7		
40 49	12.8	2.8	39.4	45.0		
50 59	4.9	5.8	31.1	58.3		
60 65	16.1	0.0	29.0	54.8		
Marital status					χ^2 436.1, d.f. 3	***
Married	12.9	0.5	40.9	45.7		
Single	41.3	55.4	0.0	3.3		
Occupational category					χ^2 634.0, d.f. 30	***
Executive	17.4	17.4	13.0	52.2		
Managerial	10.9	0.0	0.0	89.1		
Clerical	39.6	28.6	5.5	26.4		
Administrative staff	32.2	24.1	1.1	42.5		
Self employed	18.0	4.0	6.0	72.0		
Freelance professional	50.0	4.5	0.0	45.5		
Part time worker	17.5	26.8	53.6	2.1		
Housewife	0.0	0.0	100.0	0.0		
Student	26.7	71.7	0.0	1.7		
Unemployed	30.8	30.8	0.0	38.5		
Others	44.7	21.1	7.9	26.3		
Monthly allowance (yen)[a]					χ^2 166.0, d.f. 24	***
<10,000	4.5	19.7	65.2	10.6		
10,000 19,999	12.0	22.7	46.7	18.7		
20,000 29,999	18.6	20.6	31.4	29.4		
30,000 49,999	27.1	24.7	12.0	36.1		
50,000 69,999	31.0	27.6	9.2	32.2		
70,000 99,999	38.1	9.5	2.4	50.0		
100,000 149,999	57.1	33.3	0.0	9.5		
>150,000	60.0	30.0	10.0	0.0		
Unknown	23.3	11.6	27.9	37.2		
Household structure					χ^2 83.3, d.f. 12	***
Single	42.9	42.9	4.8	9.5		
Married couple	28.6	3.2	31.7	36.5		
Married with children	18.7	20.4	30.0	30.9		
Extended family	29.5	14.1	19.2	37.2		
Others	30.3	45.5	9.1	15.2		

Note: The numbers indicate percentages that horizontally sum to 100%.

[a] 100 JPY ≈ US$ 0.942 ≈ 0.744 EUR.

*** Significant at $P < 0.001$ level using Pearson chi square. No cells have expected count less than 5, with an exception of ''monthly allowance'', in which 5 cells (13.9%) have expected count less than 5.



	Content credibility	Source credibility	Informativeness	Entertainment	Irritation	General liking	Willingness to access
Cluster 1	1.94	1.83	1.87	1.69	5.27	2.48	2.06
Cluster 2	4.03	3.95	3.92	3.96	3.94	4.11	4.41
Cluster 3	2.90	2.95	3.00	2.80	4.47	3.35	2.93
Cluster 4	3.36	3.35	3.38	3.12	4.28	3.66	3.29

Fig. 3. Mean values of continuous variables. *Note*: Means of each continuous variable are significantly different across four clusters at $P < 0.001$ level using univariate F test.

informativeness, entertainment, and credibility of mobile Internet service, the more likely they were to exhibit a positive attitude and intention to access. Undoubtedly, perceived irritation was inversely correlated with both general liking and willingness to access.

Interestingly, clusters 3 and 4 showed a similar tendency in terms of attitudinal or perceptual dimensions, suggesting that they had relatively positive opinion of the value of the mobile Internet service. Nevertheless, married women (cluster 3) indicated more negative perceptions than married men, and this was consistent with research on gender difference in wired Internet adoption.

7.3. Validation of the cluster solution

Although the number of clusters was objectively determined on the basis of the BIC, it was essential to assess the stability of the cluster solution and to determine whether the cluster members were indeed homogeneous within clusters, while being heterogeneous between them. To this end, two types of dependent multivariate analyses were employed for the validation of the four-cluster solution.

First, a multinomial logistic regression was performed with eight categorical variables that were not used in the cluster analysis: average hours spent out of office/home per day, average sleeping hours, time to

Table 7
Likelihood ratio tests in multinomial logistic regression

Categorical independent variables	−2 log likelihood	χ^2	d.f.	P
Average hours spent outside	1028.7	150.0	18	***
Average sleeping hours	898.0	19.3	15	0.20
Time to wake up	931.8	53.1	18	***
Time to sleep	904.5	25.8	12	**
Average hours spent watching TV	912.8	34.1	21	**
Average hours spent listening to radio	919.4	40.6	21	**
Average hours spent reading newspaper	911.1	32.4	9	***
Monthly household expenses	919.0	40.3	18	**

** Significant at $P < 0.05$ level.
*** Significant at $P < 0.001$ level.

Table 8
Univariate tests of the predictor variables

Predictor variables	Wilks' λ	Equivalent $F(3, 561)$	P
I am primarily concerned with health issues	0.96	6.9	***
I am primarily concerned with leisure activities	0.99	1.5	0.22
I am primarily concerned with my job	0.91	19.7	***
I am primarily concerned with politics	0.91	18.5	***
I am primarily concerned with education	0.90	21.2	***
I am primarily concerned with my community	0.95	10.8	***
I am primarily concerned with my friends	0.97	5.1	**
I am primarily concerned with environmental issues	0.98	3.9	**
I am primarily concerned with aging issues	0.94	12.5	***
I frequently read newspapers	0.97	5.5	**
I frequently read magazines	0.97	6.2	***
I frequently watch television	0.98	3.4	**
I frequently read direct mail	0.94	12.6	***
I frequently read in train promotion	0.99	1.3	0.28
I frequently connect to the Internet	0.97	6.2	***
I collect the necessary information by myself	0.97	5.2	**
My friends want me to listen to their problems	1.00	1.0	0.42
I am a very social person	0.99	1.6	0.18
I can usually make a crucial decision by myself	0.96	7.5	***
I prefer to express myself in my own way	0.96	7.0	***
In a meeting I tend to coordinate different opinions	0.98	3.1	**
I always try to transmit information as accurately as possible	0.96	7.2	***
I often recommend things to my friends	0.99	1.3	0.27
I always assume leadership in a group	0.97	6.6	***

Note: All measures were assessed on a 5 point semantic differential scale from 1 (completely disagree) to 5 (completely agree).
** Significant at $P < 0.05$ level.
*** Significant at $P < 0.001$ level.

wake up, time to sleep, average hours spent watching TV, average hours spent listening to radio, average hours spent reading newspaper, and average monthly household expenses. The resulting model indicated a superbly good fit, which was statistically significant at $P < 0.001$ (-2 log-likelihood = 1145.6, chi-square = 527.4, d.f. = 132). The Nagelkerke's pseudo-R^2 was 0.62. On the basis of the chi-square statistic, the differences in -2 log-likelihood between the final model and a reduced model were assessed by the likelihood-ratio test. Table 7 shows that all predictor variables were statistically significant at $P < 0.01$, with an exception of *average sleeping hours* ($P = 0.20$).

Next, a stepwise discriminant function analysis was performed with 3 sets of self-assessment items or, in total, 24 continuous variables that were not employed in the cluster analysis: general interests in social activities (9 items), media usage patterns (6 items), and psychographic profiles (9 items). A preliminary test of univariate F found a significant effect on all except five items at $P < 0.05$ (Table 8). As shown in Table 9, three significant discriminant functions were found, which explained 100% of the total variance.

Table 9
Discriminant function analysis

Function	Eigenvalue	Percentage of variance	Canonical correlation	Wilks' λ	χ^2	d.f.	P
1	0.33	48.0	0.50	0.55	334.3	39	***
2	0.28	41.3	0.47	0.73	177.1	24	***
3	0.07	10.8	0.26	0.93	39.4	11	***

*** Significant at $P < 0.001$ level.

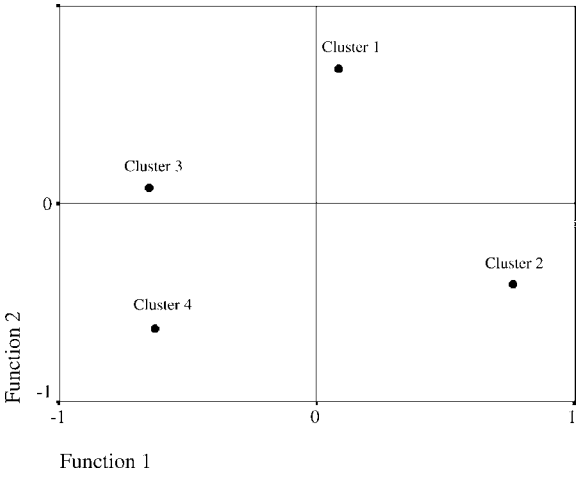


Fig. 4. Group centroids plot from discriminant function analysis.

The values of tolerance indicated that there was no serious multicollinearity. In Fig. 4, the centroids of four clusters were clearly separated on the canonical discriminant functions plot.

Furthermore, the classification matrix in Table 10 indicated that 56% of the cases in the sample were correctly classified into the four clusters, which was substantially higher than the random chance rate (26.5%), calculated on the basis of the prior probabilities for groups. Taking into account all of the above, it was therefore concluded that the results of the multivariate analyses satisfactorily validated the four-cluster solution obtained from the two-step clustering technique.

8. Limitations

Four important limitations must be considered to provide a more objective discussion. First, because of the complexity involved in omnibus research, the questionnaire was not pretested before the survey. Pretesting of an instrument is recommended as a way to improve its reliability and validity. Second, this study filtered the responses by asking respondents about their e-mail usage via mobile telephony without addressing their actual browsing of mobile Internet. Third, the attitudinal measures used were self-reported measures in response to photographic images of mobile platforms. Although this approach was practical from the perspective of collecting data, it limited the degree to which inferences may be drawn. Fourth, the sample may not have been a representative profiling of the general population in Japan, because the survey was conducted only in the greater Tokyo area.

9. Managerial implications

While research on the mobile Internet is no longer in its infancy, little empirical knowledge of the adopters' profiles exists. Our study suggested that Japanese mobile Internet adopters could be classified into four segments in terms of their attitudinal and demographic characteristics. By and large, the findings of this study have improved our understanding of strategic segmentations in mobile usage. While sporadic industry surveys had reported that young affluent males are the main adopters of mobile Internet, our study clearly demonstrated that this high-income segment actually consisted of two different clusters: cluster 1, clerical or administrative workers and freelance professionals with a negative attitude toward mobile Internet usage; cluster 2, students and clerical or part-time workers with a positive attitude toward mobile Internet usage. In cluster 1, males greatly outnumber females, while in

Table 10
Classification analysis for clusters

Actual group membership	Number of cases	Predicted group membership							
		Cluster 1		Cluster 2		Cluster 3		Cluster 4	
		n	%	*n*	%	*n*	%	*n*	%
Cluster 1	193	103	53.4	35	18.1	38	19.7	17	8.8
Cluster 2	161	29	18.0	101	62.7	11	6.8	20	12.4
Cluster 3	106	23	21.7	17	16.0	47	44.3	19	17.9
Cluster 4	114	12	10.5	17	14.9	25	21.9	60	52.6
Ungrouped cases	27	4	14.8	10	37.0	6	22.2	7	25.9

Note: Percentage of correctly classified cases 56.1%. Random chance rate 26.5%.

cluster 2 this relationship was balanced. Furthermore, it should be noted that as much as 73% below 20 years olds and 72% of the students belonged to cluster 2, and that both these clusters include a considerable number of executives.

It remains a puzzle why freelance, highly skilled professionals, such as architects, accountants, or medical doctors (who may have been included in *others*), should exhibit reluctance to adopt the mobile Internet service. This also may coincide with an observation of industry experts: that the mobile Internet service was not adopted by business and professional users 30 59 years old though they had been expected to be the most enthusiastic. This may be a warning signal for mobile operators and content providers, because the created content is putting off the most profitable segments. Hence, it is important for IT managers to examine, analyze, and explore how to turn potential user perceptions more positively to mobile Internet service.

On the other hand, this study corroborates the view that the current growth of mobile Internet owes much to young unmarried women, typically in their 20s, who live with their parents rent-free. Sociologists have coined a new phrase, 'parasite singles', to describe this group, and warn that it may become a serious social concern [45]. From a marketing perspective, however, this group may be the market mavens, actively cultivating mobile Internet adoption with their high spending power. For example, a recent survey conducted by video research in 2004 indicated that 20 30 years old female subscribers of mobile Internet service tended to use catalogue shopping very frequently; almost 26% used it more than five times a year. In contrast, only 7% of their male counterparts shopped in this way.

Various modes of strategic mobile promotions, targeting this segment, have begun to gain popularity in Japan: a cosmetic company, HABA Institute, adopted a free-sample present campaign for a new skin whitening product; a retail giant, Jeansmate, offered electronic coupons and ring-tone download; P&G executed a 'mystery campaign' for a new 'Pantene' product by offering free-samples and overseas travel [39]. The execution of such campaigns has been substantially simplified by the use of a campaign-based serial number (*Toku Number* 'beneficial number' in Japanese). Unlike a traditional URL, consumers can access a specific campaign site in a much easier way, just by inserting a five-digit number into the device.

Furthermore, a recent launch of DoCoMo's 'FeliCa' may accelerate such trends. This is an electronic transaction device equipped with contactless electronic IC chips. Combining Java-based applications, FeliCa can be used as a wallet, card, and ticket for various transactions, simply by waving the mobile in front of enabled sensors [33]. From a practical point of view, this device provides a quick solution to IT managers for the execution of mobile-based campaigns. Specifically, FeliCa should greatly increase the effectiveness of electronic coupons, as well as the use of online purchasing and reservations.

10. Conclusions

The industry is in the midst of a rapid transition from a 2.5G to a 3G network; our study provides lessons to be learnt from the Japanese experience, in terms of trusted, branded, useful, easy-to-use, holistic package of services. Despite obvious cultural and pricing differences, international mobile practitioners should consider the actions of mobile Internet adopters in Japan, given that this product and content system is being adopted in other countries. Our study provides useful insights for practitioners. The fact that affluent youth is the core segment in mobile Internet adoption is especially important, taking into account the existence of the global youth culture, members of which may share universal interests via enhanced telecommunication technologies.

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