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User Perceptions of MicroPayment Methods in Electronic Commerce

Amkela N. Malaba
Southern Cross University, amalab10@scu.edu.au

W.N Lo
Southern Cross University, blo@scu.edu.au

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Amkela N. Malaba and Bruce W.N. Lo

School of Multimedia and Information Technology
Southern Cross University, Lismore, Australia
amalab10@scu.edu.au, blo@scu.edu.au

Abstract

This paper examines the users attitude towards existing micropayment systems, in Internet-based buying and selling transactions. A survey of existing and potential users was conducted. Findings suggest that customers do want the capability of micro-transactions. However the majority regards the overhead cost of microtransactions is the responsibility of the merchant. The customers are more concerned with the utility aspect of micropayment systems. Security and privacy are the most predominant concerns. Other concerns relate to convenience, flexibility and complexity. These concerns will need to be addressed before micropayment technologies will be accepted by the average online consumer.

Keywords

E-commerce, micropayments, security, privacy, consumer attitudes

INTRODUCTION

The birth of the Internet has led to a growth in e-commerce. This growth has created an opportunity where objects, be they music on a CD or journal articles in a magazine, are no longer artificially aggregated together but can be individually sold or distributed. On the Internet the trend is towards doing things in smaller chunks-microtransactions. One can download a single song or download an article. One only pays for the part that one wants. The New York times for example, allows readers to view today's paper free but last months story costs $2.50. Forecasters expect more and more sites to start imposing smaller fees, and in some cases mere fractions of a cent (Cohen, 2001).

Other opportunities afforded by micropayment systems are in the area of short-term contracts. Currently many customers do not subscribe to Internet sites because of their reluctance to commit themselves to long-term contracts due to quality uncertainty (Choi et al, 1997). Herzberg (1998) states that subscriptions and packaging reduces the ability of the user to pick and choose at will. Micropayments enable consumers to take out short-term contracts. While micropayments are not a guarantee of quality they expose the user to less of a financial risk.

The thrust behind micropayments therefore is to make single transactions, worth as little as a few cents, feasible and viable. Micropayments are not limited to just text-based information. Brown (1997) states that there are a multitude of game sites where the technology could be used to sample the latest and hottest games. Clip-media services (where you can purchase graphics, audio and video online) are another candidate for micropayment systems. Other applications include stock quotes, custom weather reports and online training. There are other promising markets such as adult entertainment sites that would welcome a way for occasional users to sample their media anonymously. Millicent could be used across corporate Intranets for the purpose of handling departmental billing (Millicent, 2000). DigiCash states that their technology could be easily modified for anonymous online voting (Ecash, 1999).

Currently many consumers rely on credit cards for e-commerce purchases. However, using a credit card every time you make a purchase of tiny content from a site is not feasible due to the high overhead cost associated with this facility (Smalley & Patch, 1998). Transaction costs in this range can often wipe out any profits. As noted by Densmore there is a real need for micropayment systems (Brown, 1997).

The purpose of this paper is to examine the users' views and perceptions of micropayments. It is hoped that the findings will benefit all stakeholders that participate in this dynamic and growing environment. Like any study it is impossible to address all the issues that permeate a proposed area of research, but it is hoped that this paper will provide useful insights into the area of micropayments.

Based on the above discussion the objective of this study will be to firstly, assess the need for micro-transactions, secondly to determine the degree of familiarity with existing microtransaction mechanisms and to finally ascertain the users perceived concerns about micropayments.

The next section will focus on previous research. This will be followed by a description of the research method used. The article will then present the result of the data analysis and finally discuss the implications of the findings and possible future research directions.

PREVIOUS RESEARCH

In their recent review of the direction of research into electronic commerce, Kauffman and Walden (2001) identified electronic payments as one of the directions along which useful work in the area can be developed. The purpose of this paper is to explore in particular, the micropayment area.

Lee and Turban (2001) state that e-commerce success is partly determined by whether consumers are able to trust electronic systems that they have no previous experience with. Hermann and Pernul (1999) list security and integrity as crucial success factors in electronic commerce. The challenge for e-commerce is the development of technology and infrastructure for micropayments that offers an acceptable level of privacy, and is efficient, effective, secure, universal and in particular with reduced overhead transaction costs. Table 1 below summarizes the main characteristics, the advantages and disadvantages of the different micropayment methods found in the literature.

Name and Originator	Key Characteristics	Dollar Value (USD)	Advantages	Disadvantages
CLICKSHARE (Newshare) www.newshare.com	Aimed at electronic newspapers; allows host providers to set prices.	10 cents to $10	Easy to use (no client application); Royalty structure.	Fairly high transaction costs.
CYBERCOIN (Cybercash) www.cybercash.com	Bank-based coin payment system; to be bundled with Netscape (yet to happen).	25 cents to $10	Money can stay in an interest earning account until needed; can handle larger purchases.	Setup is difficult; high transaction costs.
ECASH (Digicash) www.digicash.com	A digital-cash standard that has been tested on both smart cards and the Net.	1 cent up	Anonymous; allows person-to-person transactions.	Setup is difficult.
MILLICENT (Compaq, Digital) www.millicent.digital.com	Uses vendor-issued scrip to cut down on transaction overhead.	Upward from as small as one-tenth of a cent.	Can handle transactions of as little as a fraction of a cent; low transaction costs	Merchants have their own currency; weak encryption.
NETBILL (Carnegie Mellon University) www.netbill.com	Enables customers and merchants to communicate directly with each other.	5 cents to $5	Robust encryption. Extensive certified delivery features. Can automatically adjust price based on user ID.	Complex encrypted negotiations between broker, vendor and user suggest high transaction overhead.
VIRTUALPIN (First Virtual Holdings) www.fv.com	E-mail based credit system; issues PINs used in place of credit card numbers.	$1 and up	Easy to set up (no client applet); handles big purchases.	$1 minimum transaction; fairly high transaction costs. Slow and cumbersome.
INTERNET MONDEX (Mondex International) www.mondex.com	Leading smart card vendor; provides a direct electronic equivalent.	"A few cents" and up	Allows person-to-person transactions; works in both cyberspace and real world.	Requires smart card reader.
MINIPAY (IBM) www.ibm.com	Directed mainly at billing systems including banks and financial institutions.	1 cent to $10	Low transaction cost; easy to use; supports multi-currency.	Not suitable for high priced purchases.

Table 1: A Comparison of Different Micro-payment Systems [Source: Brown (1997) & Lehmann (1999)]

Micropayment systems exhibit a variety of characteristics, Lehmann (1999) provides a taxonomy which classifies micropayment systems into 5 major categories, intrinsic, extended, security, privacy and system aspects. Table 2 provides a comparison of 4 micropayment mechanisms with reference to four of these characteristics. The characteristics are: privacy: (the claim of individuals, groups, or institutions to determine for

themselves, when, and to what extent, information about them is communicated to others.), security: (the assurance of the integrity, authenticity and confidentiality of the transaction.), scalability: (the ability of the payment mechanism to support a large number of users simultaneously and to adapt to meet changing requirements.), and universality: (the extent to which the transaction mechanism is accessible or accepted globally).

	Cybercoin	**Ecash**	**Millicent**	**Minipay**
Scalability	Its scalability is limited by regulation in the U.S, as the cybercash Gateway acts as a real bank.	Not very scalable, as it keeps a database of the serial number of every coin ever spent in the system.	Very scalable. The division of work between the parties enables the creation of a large number of issuers and acquirers who work together with an almost unlimited number of merchants.	Multiple interoperable systems.
Security	CyberCash Gateway acts as both issuer and acquirer. Provides authenticity through RSA digital signatures. The RSA provides integrity and the DES provides confidentiality.	Ecash system does not rely on any trust party. Authenticity is provided through signing with RSA digital signatures	Signing with a salted hash guards integrity and authenticity of the script.	Uses public keys to authenticate parties
Privacy	It is not anonymous. The cybercash gateway records the identity of the client, merchant, the amount of money exchanged and the time of the transaction.	Provides a fully anonymous transaction.	Does not cover unobservability and parameter secrecy depends on the way the system is operated and configured.	Based on a peer to peer relationship, where public keys are exchanged and authenticated using relationships between peers.
Universality	Currently only available in the U.S	Is not universal	Universal. The system does not require the use of a specific financial institution or company	Universal. Multiple currencies; supports conversion.

Table 2: A Comparison of four Micropayment Mechanisms by Security, Privacy, Scalability and Universality. Source: Lehman (1999)

In this study we attempt to focus our study on the characteristics that are of more concern to the user. These include security and privacy defined above. We introduce three more characteristics, flexibility, convenience and complexity. They are defined as follows; flexibility: the degree to which the transaction mechanism is easily divisible, acceptable and exchangeable between customers, merchants and brokers. Convenience: the capability of the transaction mechanism to be used at anytime, as and when required. Complexity: the degree to which the transaction mechanism is easy to setup, learn and use.

METHODOLOGY

The objective of this research is to determine user perceptions of micropayment systems by measuring the following variables:

- whether they believe there is a need for micropayment systems
- their degree of familiarity with various micropayment systems
- their perceived likeness in form to credit cards, EFTPoS, telegraphic transfers, automated teller machines and cash.
- the users main concerns in micropayment payment systems with respect to security, flexibility, privacy, convenience, complexity.
- to ascertain whether there are any differences of these perceptions based on demographics characteristics.

The research follows the standard survey methodology. The pilot study was administered to 15 subjects consisting of postgraduate and undergraduate university students. Several questions that produced inconclusive or not meaningful results were revised.

Sample

The sample consisted of students, university staff, business people and information technology professionals. The students were from various nationalities studying a variety of disciplines. The university staff members were from both academic and non-academic departments. The business people comprised small to medium size business owners in northern New South Wales. The information technology professionals were individuals working within both the software and hardware industries. Thus, the sample was representative of individuals with diverse interests from different disciplines.

Survey Instrument

The survey form contained 22 questions, seeking information on the respondents perception on micropayment systems, Online purchase experience, Internet access and the respondents demographics.

The questions generally progressed from the broad to the specific with reference to payment systems. Pre-coded questions were used to achieve a higher level of focus and to minimize the respondents from distorting responses (Glastonbury & Mackean, 1986, Richardson *et al*, cited by Nay-brock, 1984). Questions 1 to 7 were used to measure the respondents Online experience, whether they had ever purchased Online, what methods they had used, the number of hours per week and years of Internet access and what experience and concerns they had with Internet Payment Systems (IPS). Questions 8 to 17 specifically probed the subjects knowledge of micropayment systems, whether they had used them, which particular types they were familiar with and whether they deemed them necessary. It also asked the respondents to compare micropayment systems (MPS) with other forms of payment systems and how best they believed the overhead cost should be distributed. Questions 17 to 22 gathered demographic information. The structure of the questionnaire is summarised in Table 3.

Question Sequence	**What the questions target**	**Key Elements of the questions**
Section 1 Questions 1 to 7	Online experience with the Internet	Location of online access Hours online per week Years of Internet access Number of online purchases Payment methods used on the Internet Use of micropayments Users concerns with IPS
Section 2 Questions 8 to 17	Knowledge of and opinion towards micropayment systems	(See the Appendix for details of questions).
Section 3 Questions 18 to 22	Demographics	Age Gender Occupation Level of education Income level

Table 3: Structure of the Questionnaire

Survey Procedure

The survey was conducted in paper form. A letter accompanied the questionnaire introducing the researchers and informing the respondents what the research was about. It also assured them of the confidentiality of their identities and information provided. Subjects were asked to complete the questionnaire individually. The students were approached during class times after permission had been granted by their lectures. The university staff members, business people and information technology professionals were approached in their offices or places of work. Since the questionnaire only took a few minutes to complete, in most cases, the respondents were asked to complete the survey while the researchers waited.

DATA ANALYSIS

The number of useable responses is 121 (n=121). The following analysis is based on this data. Figures 1-7 show the demographic characteristics of the sample. The largest group (33%) of the respondents were between 26 and 35 years of age. It is interesting to note that about half (47%) of the respondents had purchased on the Internet and 26% had purchased 3 or more times. 48% of the respondents had been accessing the Internet for between 4 and 6 years with just over a third of the users, 34% accessing the Internet for more than 5 but less than 10 hours per week. The majority, 77% of the respondents believed that micropayment systems were important.

Figure 1:Age Distribution

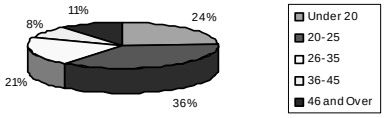


Figure 2: Occupation

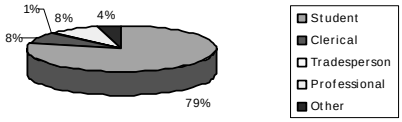


Figure 3: Internet Access

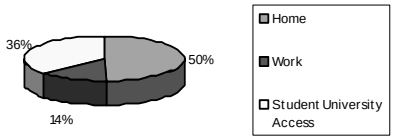


Figure 4: Number of Internet Purchases

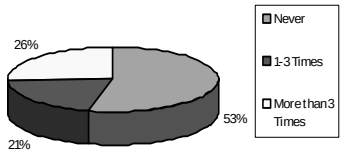


Figure 5: Internet Access Hours per Week

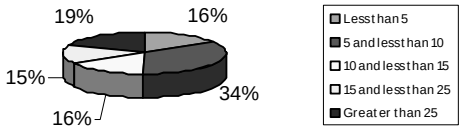


Figure 6: Internet Access: Number of Years

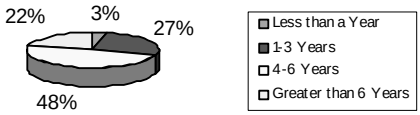
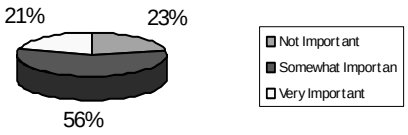
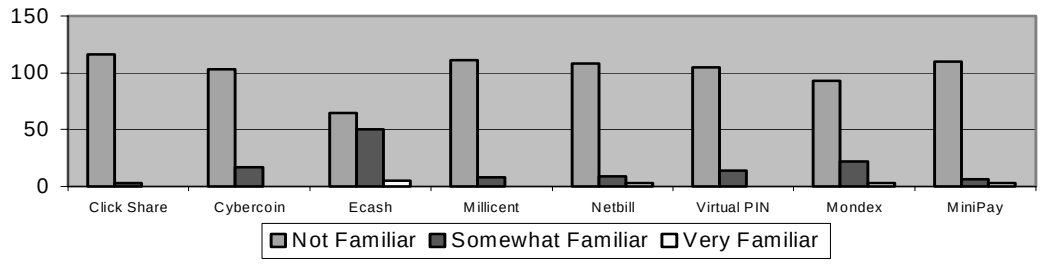


Figure 7: Importance of Micropayment Systems

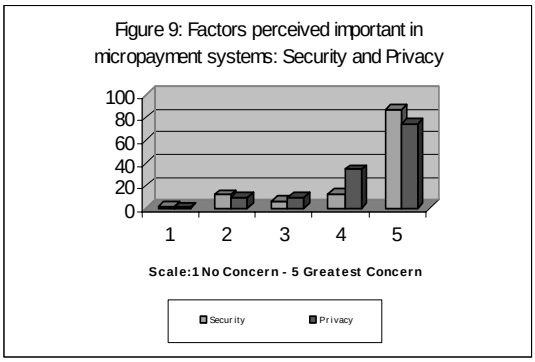


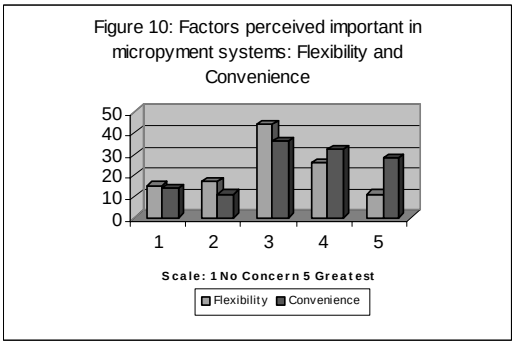
The graph below shows familiarity ratings with various types of micro-payment systems. It was apparent that the majority of the respondents were not very familiar with existing micropayment mechanisms. However, it appears that Ecash and Mondex are the better known, with 55 and 25 respondents respectively stating to be familiar with these mechanisms.

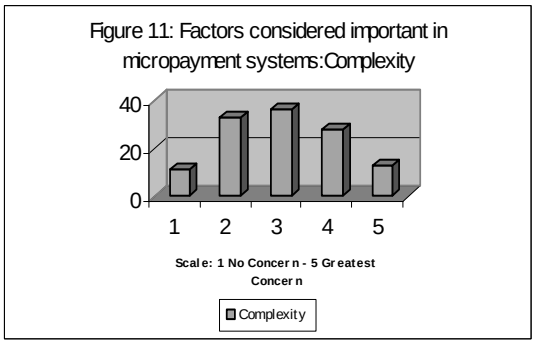
Figure 8: Familiarity with Micropayment Systems

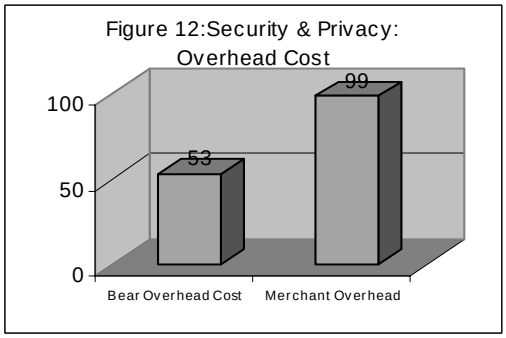


The following Figures 9-12, show what the subjects regarded as important characteristics to be found in micropayment systems.







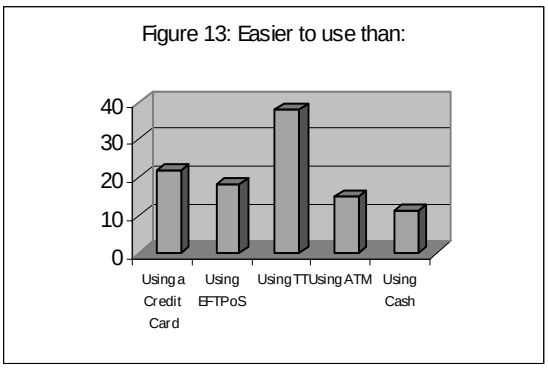


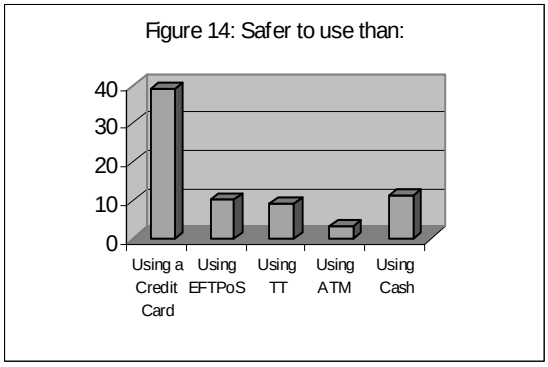
It is clear that of greatest concern are the twin issues of security and privacy as in both cases over 83% of the respondents indicated this. Respondents appear to have both negative and positive views on flexibility and convenience, while the number of respondents is spread with respect to complexity. On the issue of who should bear the overhead transaction cost the majority of the respondents 82% indicated that they believed that the cost should be passes onto the merchant.

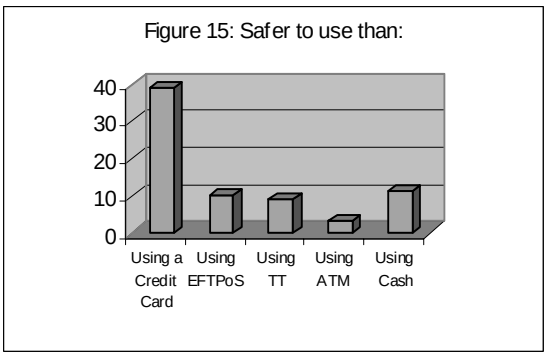
Next the respondents were asked to compare micropayment systems to the various other payment systems with respect to ease of use, safety, flexibility and privacy. The results are shown in Figures 13-16. Table 4 displays how micropayment systems rated with respect to the other payment systems. It is obvious that ease of use and flexibility rated better but the subjects were not as sure with respect to security and privacy. This appears to reflect the greater concerns expressed in Figure 9.

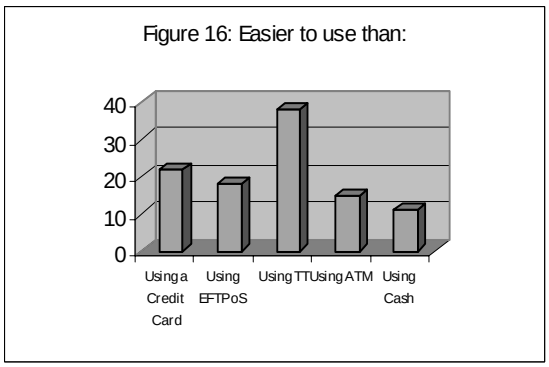
	Better than at least 1	**Not better than any**
Easier	71%	29%
Safer	57%	43%
More Flexible	70%	30%
More Privacy	66%	34%

Table 4: Micropyment systems vs Payment systems









Next we investigate whether any of the demographic (independent) variables have any bearings on the dependent (perception) variables. Analysis of variance was conducted on each of the following using the SPSS package: perception of the efficiency of the micropayment mechanism, importance of security, importance of flexibility, importance of the need for privacy, importance of the need for convenience, and importance to avoid complexity in micropayment systems. The independent (group) variables are: age, gender, occupation, income level, whether respondents have used micropayment before, Online purchase experience, experience with Ecash and Mondex. The significant results are shown in Table 5. An examination of the Table shows,

- different "age" groups differ significantly in their perception of *privacy*, *convenience* and *complexity*;
- different "*occupation"* groups differ significantly in their perception of *flexibility* and *complexity*;
- different *"income"* groups differ significantly in their perception of *convenience.*

All the remaining results were insignificant.

Dependent Variable	**Independent Variable**	**d.f.**	**F**	**Sig.ρ**
Flexibility	Occupation	120	3.099	0.018
Privacy	Age	120	2.840	0.027
Convenience	Age	120	3.189	0.016
	Income	120	2.532	0.044
Complexity	Age	120	2.828	0.028
	Occupation	120	3.908	0.005

Table 5: ANOVA Results

DISCUSSION

The results suggest that micropayments are still in their infancy and no single system has emerged as the dominant system. The vast majority of the respondents were not familiar with the existing micropayment mechanisms that were available. However Ecash and Mondex were the better known. This may suggest that there are too many micropayment mechanisms to contend with. It is probably impractical to expect merchants to support all of them.

There is a clear indication that users perceive security and privacy issues are of the greatest concerns when paying over the Internet. Nearly 83% of those responded expressed this sentiment. This highlights the need for e-merchants to clearly promote their payment methods to the customer as ones that will uphold security and privacy, otherwise they may fail to convince potential customers to use the Net-based payment methods. However, in terms of the complexity of the payment method, there was not such consensus. In other words,

respondents appear to be spread in their views on whether complexity is an important issue or not. Surprisingly, over 62% of the respondents believe that flexibility of micropayment methods is not an important issue, while 50% believe that convenience is not an important issue.

It is interesting to note that, due to the lack of familiarity with micropayment methods, there is a diversity of views as to what micropayments are like compared to other forms of payment methods. 43% of the respondents perceived micropayments to be similar to using a credit card and 55% perceived them to be similar to using EFTPoS. This may be due to the fact that credit cards are the most dominant mechanism currently in use for purchases over the Internet particularly for non-microtransactions. It would seem to indicate that for a micropayment method to win wide acceptance, it would need to integrate seamlessly with exiting credit card systems. Electronic wallets (Schneider & Perry 2000) will provide a means to achieve this.

There is ample opportunity for further research in micropayment methods, both from a technical as well as psycho-social perspective. This paper is but a small step in a fruitful area of research.

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APPENDIX 1

Below are details of Questions 8 to 17 in Section 2 of the Questionnaire

8. In your opinion how important do you think it is to be able to conduct microtransactions on the Internet - ie. transactions that cost a dollar or less (eg. purchase a single song as opposed to an entire CD)

0 Not important
1 Somewhat important
2 Very important

9.Identify if you would make use of each of the following types of e-commerce microtransactions if they were available (**tick all**)

A song on a CD	1	Yes	0	No
An article in a book/magazine/journal	1	Yes	0	No
Online graphics/audio/video/movie	1	Yes	0	No
Online stories/novels	1	Yes	0	No
Stock quotes/weather reports/news items	1	Yes	0	No
Online games/screen savers	1	Yes	0	No
Online lottery/casino/gambling	1	Yes	0	No
Online match making	1	Yes	0	No

10. How familiar are you with each of the following micro-payment mechanisms?

	Not Familiar	Somewhat Familiar	Very Familiar
Clickshare			
Cybercion			
Ecash			
Millicent			
Netbill			
VirtualPIN			
Mondex			
MiniPay			

11. In your opinion are micro-payment systems efficient? (By efficient we mean; for the amount of effort you put in is the result satisfactory?)

1 Yes 0 No

12. One of the major problems of micro-payments is the high overhead for the merchant if the conventional credit/debit card is used. From your point of view as the customer, indicate your willingness to accept or not accept the following strategies;

a. My main concern is security and privacy. I am willing to bear the overhead cost.

1 Yes 0 No

b. Part of the overhead cost should be passed to the customer and part born by the merchant.

1 Yes 0 No

c. All of the overhead cost should be born by the merchant.

1 Yes 0 No

d. While my main concern is security and privacy, the cost of implementing security and privacy should still be born by the merchant.

1 Yes 0 No

13. In your opinion micro-payment systems are similar to using; (**tick all relevant**)
14. In your opinion are micro-payment systems easier to use than; (**tick all relevant**)
15. In your opinion are micro-payment systems safer to use than; (**tick all relevant**)
16. In your opinion are micro-payment systems more flexible to use than; (**tick all relevant**)
17. In your opinion do micro-payment systems offer more privacy than; (**tick all relevant**)

1 Credit Card
2 EFTPoS
3 Telegraphic Transfer
4 Automated Teller Machines
5 Cash
6 None of the above

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