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Predicting young consumers' take up of mobile banking services

Abstract

Purpose – This paper aims to investigate the barriers for adopting mobile banking services. From a methodological perspective, this study seeks to build on two widely used models for technology adoption, the Technology Acceptance Model (TAM) and Innovation Diffusion Theory (IDT) and to test a model that is better able to predict consumers' intention to use mobile banking.

Design/methodology/approach – A research model extends the TAM model by additionally examining the effects of compatibility, trust, credibility, perceived risk and cost on behavioural intention. The empirical approach was based on an online survey of 263 young people in Germany, undertaken during August/September 2009. The data were analysed using structural equation modeling.

Findings – The results of the study indicated that compatibility, perceived usefulness and risk are significant indicators for the adoption of m-banking services. Compatibility not only had a strong direct effect but was also identified as an important antecedent for perceived ease of use, perceived usefulness and credibility. Trust and credibility are crucial in reducing the overall perceived risk of m-banking.

Originality – The results of this study has implications for researchers and practitioners. The proposed model explained 65% of the variance in intention to adopt mobile phone banking, which is more than the 40% of variance typically found in other studies using the Technology Acceptance Model. This study has provided a basis for further refinement of models to predict technology adoption, in particular the inclusion of compatibility as a predictor of behavioural intention. In terms of behavioural and demographic data, the study has focused on segments of individuals who are most likely to adopt m-banking.

Keywords: m-banking, TAM, IDT, technology adoption, trust, risk, young people

Paper type: Research Paper

Predicting young consumers' take up of mobile banking services

Introduction
The Internet has had a significant impact on financial institutions, allowing consumers to access many bank facilities 24 hours a day, while allowing banks to significantly cut their costs. Research has shown that online banking is the cheapest delivery channel for many banking services (Robinson, 2000; Sathye, 1999). A number of studies have identified advantages to bank customers, including cost and time savings as well as spatial independence benefits (Howcroft *et al.*, 2002; Polatoglu and Ekin, 2001). Uptake of online banking has been particularly great among young people (Calisir and Gumussoy, 2008).

The Internet has evolved from its fixed line constraints and is increasingly mobile. Mobile phone handsets, which were initially used almost exclusively for voice calls are now often used to transmit data and undertake commercial transactions. In recent years, mobile phones have become very popular with a penetration rate in many parts of Europe approaching 100% (Eurostat, 2009b). A growing proportion of these are equipped to handle data, as well as voice calls (ICT Statistics, 2009). The term mobile commerce (m–commerce) has been widely used to describe a subset of e-commerce and refers to transactions with monetary value which are conducted via mobile devices (Clarke, 2001; Coursaris and Hassanein, 2002).

Banking was at the forefront of the services sectors that sought to migrate customers from face-to-face transactions to computer mediated transactions. With the development of m-commerce, similar expectations have been held out that much banking activity that is currently carried out online through fixed line Internet terminals will migrate to mobile devices. M-banking enables customers to access their bank accounts through mobile devices to check their balance or to conduct financial transactions. The range of services that can be undertaken while mobile is likely to increase, and mobile phones are likely to evolve as ubiquitous payment devices (Wilcox, 2009a). However, it has been claimed that m-banking does not provide significant cost saving benefits for banks in comparison to those that can be achieved by migrating customers from traditional banking methods to online banking (Laukkanen *et al.*, 2007). Therefore the development of m-banking is more likely to proceed only if customers see it as a source of competitive advantage for a bank which offers it, compared to those which do not (Mallat *et al.*, 2004). If consumers do not see advantages in m-banking, it is unlikely that banks will significantly increase resources used to support it.

Many estimates of likely take up of m-banking have been made, for example Juniper Research suggested that worldwide, the number of consumers using m-banking will reach 816 million by 2011, which is a tenfold increase on the number using these services in 2007 (Goode, 2008). In addition, it is predicted that by the end of 2011 more than 150 million subscribers worldwide will have used their mobile phone not only for

banking information services but also for transactional m-banking services (Wilcox, 2009a).

However, in the short life of m-commerce, forecasters appear to have had only limited success in accurately predicting take up of m-banking, which reportedly still does not meet industry expectations (Kim *et al.*, 2009). Forrester research reports that only 4% of the nearly 25 million Bank of America's online customers are active users of m-banking (Khan, 2008). A study of German consumers found that only 12% would consider using mobile phones for banking or shopping (Tanner, 2008). Younger consumers (aged 25 to 34) are particularly interested in this application (Sraeel, 2006). Young people are more predisposed to adopt m-commerce services than other Internet users because these services are usually low cost entertainment products (e.g. ringtones, songs) which fit with their lifestyle (Bigne *et al.*, 2005). Technology providers and financial institutions believe that m-payment will reach critical mass in the next few years (Edgar *et al.*, 2008). However, there is a common belief that consumer adoption is the most significant barrier to the development of m-banking. It is therefore necessary to understand what prevents consumers from adopting m-banking.

Perceived risk and trust are interlinked concepts and have been frequently identified as key barriers to adopting online and mobile services (see Featherman and Pavlou, 2003; Gefen *et al.*, 2003; Lee and Turban, 2001) Consumers' trust needs to be built and maintained over time and an understanding of consumers' risk perception is helpful to banks in identifying barriers to adoption that have to be overcome. In the context of m-banking, recent research has demonstrated that the lack of perceived credibility has been a significant concern to bank customers, manifested, for example through fears that personal information or money might be transferred to third parties without users' knowledge (Luarn and Lin, 2005; Wang *et al.*, 2006; Wang *et al.*, 2003). Kim *et al.* (2009) posit that as m-banking is perceived as riskier than non-mobile banking, a person's initial trust in the service is a critical factor for the success of m-banking.

The aims of this study are threefold. Firstly, it aims to provide further insight into the factors that lead consumers to express an intention to use m-banking services. Secondly, from a methodological perspective, it examines two widely used bases for forecasting technology adoption - the Technology Acceptance Model (TAM) and Innovation Diffusion Theory (IDT) and seeks to build on these to develop and test a model which is better able to predict consumers' intention to use an innovative technology, in this case m-banking services. Thirdly, our research integrates perceived risk and trust into these established models. We feel, that both constructs are crucial to the successful adoption of m-banking, however, they are not yet well explored in the literature in the context of m-banking.

Conceptual development
The proposed research model is an extension of two theories, Technology Acceptance Model (TAM) and Innovation Diffusion Theory (IDT). These theories have been widely used in numerous empirical studies of consumers' uptake of new technologies (e.g.

Igbaria *et al.*, 1995; Taylor and Todd, 1995). In particular, they have been extensively used to study the acceptance of e-commerce applications (e.g. Chen *et al.*, 2004; Gefen and Straub, 1997; Koufaris, 2002), as well as various m-commerce applications (e.g. Aldás-Manzano *et al.*, 2009; Koivumaki *et al.*, 2006; Lu *et al.*, 2007; Luarn and Lin, 2005; Yu *et al.*, 2003). Thus, these theories provide an excellent theoretical foundation for the study of m-banking.

TAM and IDT
TAM is an adaptation of the Theory of Reasoned Action (TRA) which claims that behaviour is a direct consequence of behavioural intention (Fishbein and Ajzen, 1975). According to TAM, behavioural intention is influenced by a user's attitudes towards a product which in turn is affected by the perceived usefulness of the product and its perceived ease of use (Davis *et al.*, 1989). Perceived usefulness refers to the degree to which using a specific product will increase a user's ability to achieve desired goals, whereas perceived ease of use refers to the extent to which the use of the system is free of effort (Davis *et al.*, 1989). Research has suggested that usefulness is a significant factor for the acceptance of mobile services (Koivumaki *et al.*, 2006; Wang *et al.*, 2006).

However, some authors criticise TAM because of its deterministic approach on the decision to adopt or reject a novel technology (McMaster and Wastell, 2005). One important criticism is that studies typically use as an outcome variable, the *intention* to utilise a new technology, rather than actual behaviour in adopting it. Intentions mirror the motivational factors that affect users' behaviour, i.e. how hard users are willing to attempt to perform a behaviour (Ajzen, 1991). The stronger one's intention to engage in a behaviour, the more likely he or she will actually do it (Ajzen, 1991). Research has suggested that TAM typically explains about 40% of the variance in usage intentions and behaviour (Venkatesh and Davis, 2000).

The second underlying conceptual approach which informs this research is IDT (Rogers, 1995, 2002). The theory recognizes that the adoption of an innovation is not typically a straightforward process (Bouwman *et al.*, 2007). In general, innovations should be perceived by consumers as having greater relative advantage, observability, trialability, compatibility, and less complexity; in this case, the adoption rate will increase (Rogers, 2002). However, a number of studies have shown that only relative advantage, complexity, and compatibility have a significant effect on the adoption rate of innovatory products (e.g. Agarwal and Prasa, 1998; Lee *et al.*, 2003).

It has been suggested that TAM and IDT complement each other. Relative advantage is very closely related to the construct of perceived usefulness of an application, whilst complexity refers to the perceived ease of use in the TAM approach (Moore and Benbasat, 1991). Compatibility is an important aspect of innovation which can be defined as the extent to which a new service is consistent with users' existing values, beliefs, previous experiences, habits (Chen *et al.*, 2002). Innovations conforming with an individual user's lifestyle will result in a faster rate of adoption (Rogers, 1995). Compatibility has thus been integrated into the TAM model in the context of a virtual

store (Chen *et al.*, 2002), m-payment (Chen, 2008) and m-commerce (Wu and Wang, 2005). Research has shown that compatibility will lead to higher perceived ease of use as less effort is required (Agarwal and Karahanna, 1998; Wu and Wang, 2005). Furthermore, Agarwal and Karahanna (1998) state that more innovative, and thus more experienced users, will recognise the value of the innovation more easily. In the context of m-banking, some consumers are more mobile phone literate than others and, consequently, would be expected to have fewer problems utilising m-banking and getting accustomed to it quickly. Furthermore, these innovative customers are likely to place greater trust in the channel/competence underlying the technology. The inclusion of compatibility beliefs into the TAM model could hence be very useful for explaining the adoption of m-banking.

Figure 1 illustrates the hypothesised relationships between the constructs. The first set of hypotheses seeks to validate, constructs previously used in the TAM and IDT.

H1. Perceived usefulness and perceived ease of use will lead to higher behavioural intention to use m-banking. Furthermore, perceived ease of use positively affects perceived usefulness.
H2. Compatibility will lead to higher behavioural intention to use m-banking. In addition, compatibility positively affects perceived usefulness, perceived ease of use and credibility.

This research seeks to build upon the common elements of the TAM and IDT by adding into a conceptual model a number of constructs that have frequently been cited in the consumer behaviour literature, but not adequately incorporated into these underlying theories. The concepts of perceived risk, trust and credibility are common barriers in the consumer purchase process. Furthermore, the cost of using an individual product is not adequately taken into account. The justification for incorporating risk, trust, credibility and costs in an extended model of TAM and IDT is presented below.

Perceived Risk, Trust, and Credibility
The decision to purchase an innovative product, which is innovative both to the market and to the individual buyer can involve a high level of perceived risk. Perceived risk has been conceptualised in terms of two principal components – the probability of something happening, and the consequences of the outcome (Cunningham, 1967, p.83). It is a multidimensional concept and six types of perceived risk have been identified in the literature, i.e. performance, financial, physical, social, psychological, and time risk (Greatorex and Mitchell, 1994; Stone and GrØnhaug, 1993). However, from a customer's point of view it is potentially difficult to assess and differentiate the various risk dimensions meaningfully (Zhao *et al.*, 2008), especially if they had not much experience of m-banking services. This is supported by Wolfingbarger and Gilly (2003) who state that clients might find it difficult to evaluate the financial risk related to online or m-banking.

In the case of m-banking, the intangibility of the service prevents potential customers being able to evaluate the service in advance. Research has shown that in the context

of Internet banking, consumers are often anxious about security issues and their privacy (Gerrard et al., 2006). Online banking and m-banking operate in a distant and impersonal environment and make extensive use of open technological infrastructure which can create implicit uncertainty through fears of hacking and other malicious attacks resulting in financial losses or manipulation of personal data (Laukkanen *et al.*, 2007; Yousafzai *et al.*, 2003). Consequently, perceived risk might be higher for online and m-banking compared to a "traditional" bank account which includes face-to-face transactions.

There is evidence that an individual's level of perceived risk is negatively related to their attitude towards using Internet services (Polasik and Wisniewski, 2009). Chen (2008) found that risk negatively affects consumers' intention to adopt m-payment. Amin's study (2008) about the adoption of mobile phone credit cards suggests that customers require a system which is completely secure.

Trust is related to risk and it was noted by Mayer *et al.* (1995, p.711), that "the need for trust only arises in a risky situation". Morrison and Firmstone (2000, p. 600) posit that "risk and trust are inseparable components in decision-making". Trust is an effective method to overcome fears associated with perceived risk and uncertainty (Gefen, 2000), and has a favourable effect on consumer purchase intentions (Jarvenpaa *et al.*, 1999). Trust has been defined as "the subjective probability with which consumers believe that a particular transaction will occur in a manner consistent with their confident expectations" (Chellappa and Pavlou, 2002, p.359). Furthermore, lack of trust is a frequently cited reason why buyers do not purchase from Internet shops (Gefen *et al.*, 2003; Lee and Turban, 2001; McKnight *et al.*, 2002). Since consumers have only limited cognitive resources available, they attempt to reduce the complexity and uncertainty of transactions in electronic markets by applying mental shortcuts such as trust (Grabner-Kräuter and Kaluscha, 2003). Trust should not be confused with familiarity which deals with an understanding of current actions whereas trust deals with beliefs about future actions of other people (Gefen, 2000).

The concept of trust is likely to be an important antecedent of individuals' decision whether or not to adopt m-banking. Evidence of this was found by Kim *et al.* (2009) who observed that initial trust is significantly positively associated with consumers' intention to adopt m-banking. Two types of trust are crucial when assessing the potential barriers of m-banking acceptance: institutional trust and trust in the channel/technology (Stewart, 1999; Yousafzai *et al.*, 2003). Research has shown, that initial trust is influenced by institution-based trust which refers to the individual's perceptions of the institutional environment (McKnight *et al.*, 2002). Trust in the institution is a key issue in improving consumer's trust relating to the electronic banking infrastructure (Yousafzai *et al.*, 2003), thus reducing the overall perceived risk. Only if consumers have built sufficient trust in the institutions involved in m-banking, are they prepared to transfer this positive belief to the m-banking channel/technology (Rotchanakitumnuai and Speece, 2003).

Another important concept likely to affect uptake of m-banking services, and not adequately reflected in current models, is perceived credibility. Perceived credibility, is broadly defined as the belief that a partner is trustworthy and has the required expertise to carry out transactions (Erdem and Swait, 2004). Luarn and Lin (2005) posit that the lack of perceived credibility is evident in potential consumers' worries that personal information and/or money might be transferred to third parties without their knowledge whilst using m-banking. In this study we will apply the concept of perceived credibility based on Wang *et al.* (2003) who defined it as the degree to which a potential user believes that the service will be free of security and privacy threats. Research has suggested that credibility has a significant positive effect on the adoption of online banking (Wang *et al.*, 2003) and m-banking (Luarn and Lin, 2005). Furthermore, as m-banking consumers mainly interact with the bank through their mobile device, easy-to-use services should facilitate the creation of trust (Gefen *et al.*, 2003). Recent studies into the adoption of mobile services have shown that perceived ease of use has a positive influence on consumer's perception of credibility (Luarn and Lin, 2005; Wang *et al.*, 2006).

The research seeks to add the variables of risk, trust and credibility to a predictive model through the following hypotheses:

H3 Perceived trust will lead to higher behavioural intention to use m-banking, whilst perceived overall risk will lead to lower behavioural intention to use m-banking.

H4. A buyer's level of trust in a bank influences their level of perceived risk and credibility in it.

H5. Perceived ease of use positively affects perceived credibility. In addition, perceived credibility will lead to higher behavioural intention to use m-banking.

Costs of use
A barrier to the adoption of innovative new technologies is often the perceived cost of acquisition and use. In addition to actual transparent and quantifiable costs of acquisition and use, adopters typically face a range of relatively hidden "transaction costs" which are likely to influence whether they adopt mobile commerce (Hung *et al.*, 2003; Wu and Wang, 2005). Gressgard and Stensaker (2006) suggest that switching costs are very high for customers due to technological uncertainty.

Several studies suggest that perceived costs could be a major barrier for the adoption of m-banking (e.g. Dahlberg *et al.*, 2008; Kleijnen *et al.*, 2004). Wu and Wang (2005) found that costs have a significant negative effect on users' behavioural intention to use m-commerce. On the other hand, lower costs, e.g. due to banks passing on lower processing costs and lower perceived costs of correcting errors, can motivate consumers to use electronic banking (Sathye, 1999). The following hypothesis is thus posited for this research:

H6. High perceived cost will lead to lower behavioural intention to use m-banking.

Figure 1: Research Model
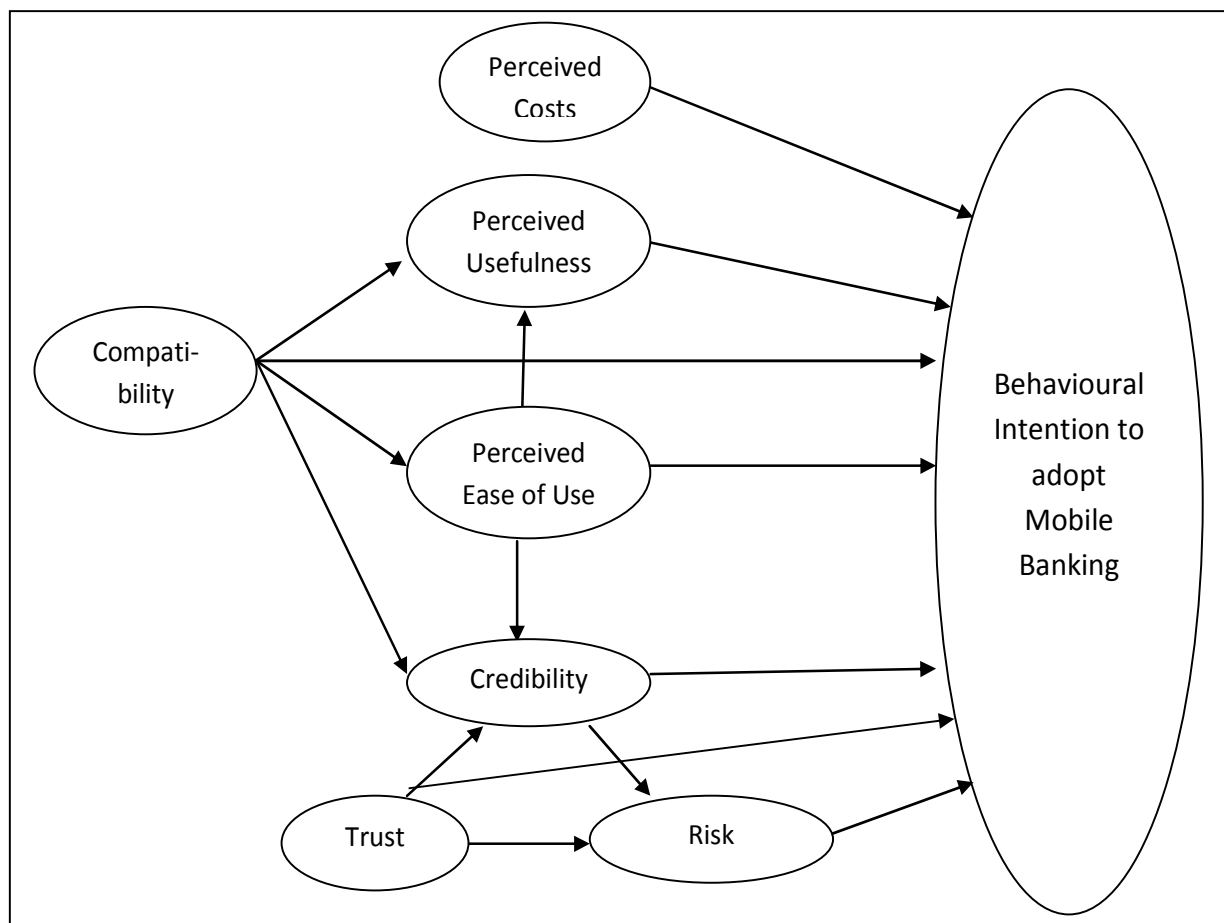
Methodology
An aim of this study was to improve the predictive ability of established models for forecasting uptake of new high technology services; therefore the methodology employed was, like that used by preceding models, predominantly quantitative. A survey instrument was developed based on previously validated scales, and administered online. The hypotheses were tested using data gathered from a sample of young German consumers.

Data collection
The hypotheses were tested using consumers aged 18 to 35, resident in Germany. Younger people are of particular interest, because it has been noted that these are typically early adopters of innovative technologies, which eventually filter through to older age groups (Luo, 2009). To minimise the effects of differences in culture and the economic/technological/legal environment, the study was confined to one country. Germany provides a good case for the study of innovation adoption. Eurostat (2009b) shows that Germans are heavy users of information and communication technology, ranking 5th in Europe behind Netherlands, Sweden, Denmark and Luxembourg for the

percentage of households with Internet access (71% in 2007). Around 60% of the population had medium or high level of computer skills. German consumers make extensive use of online ordering, with over half of all individuals between 16 and 74 reporting to have made an online purchase in 2007 (Eurostat, 2009b). These figures are even higher for young people. For example, in the first quarter of 2008, 88% of Germans aged between 25-44 and 76% aged between 16-24 with Internet access purchased goods and services online (Statistitisches Bundesamt (Federal Statistical Office), 2009). Only 19% of all individuals with Internet access had never made an Internet purchase, the second lowest percentage in Europe (Eurostat, 2009a).

Data was collected during August and September 2009 using an online survey questionnaire. There is now considerable evidence of their efficiency and effectiveness in collecting data, especially from young people who formed the focus for this study (Luo, 2009; Wilson and Laskey, 2003). For this study, the online questionnaire was distributed via http://ofb.msd-media.de. A convenience sample was used, consistent with the approach adopted in many previous studies of technology adoption (e.g. Chen, 2008; Featherman and Pavlou, 2003; Luarn and Lin, 2005; Wu and Wang, 2005). This was operationalised through a modified snowball approach, whereby contacts of the researchers and their contacts were invited through a social network website to take part in the research. Among the target population, there is evidence of widespread membership of social network websites, thereby limiting problems of response bias. Research carried out by comScore has shown that the total Germany Internet audience has reached 37.6 million visitors in January 2009. Furthermore social networking sites have grown by 36% to 23.6 million visitors (comScore, 2009). Nielsen estimated that 51% of the German online audience have visited social networking sites and blogs in December 2008 (Nielsen Online, 2009). Using this approach, it is estimated that between 600-900 people received an invitation to take part in the study. From this, a total of 263 responses were received, of which 155 were complete. To qualify for inclusion in the sample, respondents were required to be aged between 18 and 35. This represents a response rate of between 29.2% and 43.8%. This may be considered high, and may reflect the fact that a recipient is more likely to respond favourably to a survey invitation which comes from a known contact rather than the coming from an organisation with whom there has been no previous personal contact.

In order to assess the validity of the sample, the questionnaire sought demographic and behavioural information with regard to respondents' current use of mobile phones. Sample characteristics are summarised in table one.

Table 1: Sample characteristics

Measure	Items	Frequency	Percentage
Gender	Male	99	63.9%
	Female	56	36.1%
Type of Mobile Phone	Smartphone	27	17.4%
	Other mobile phone	128	82.6%
Contract	Pay-as-you-go	33	21.3%
	Contract	122	78.7%
Mobile Services (e-mail, Internet, WAP)	Yes	34	21.9%
	No	121	78.1%
Online Banking Usage	Never	35	22.6%
	Up to twice a month	34	21.9%
	At least 3 times a month	86	55.5%

Note: percentages refer only to those respondents who gave full demographic and behavioural data.

An attempt was made to validate the sample by reference to known national statistics of mobile phone and online banking usage. Around 17% of the sample owned a smartphone, which compares with evidence from Nielsen that 12% of all new mobile handsets purchased in Germany were smartphones. Nielsen research has also shown that US smartphone users are predominantly male (65% of all users) and more likely to be between 25 and 34 years old (Quick, 2009). This suggests that the smartphone ownership level among young people in Germany may be slightly higher than for the whole population. In 2008, 61% of Germans aged between 25-44 with Internet access had used online banking during the first quarter of 2008 (Statistisches Bundesamt (Federal Statistical Office), 2009), lower than the sample figure of 77.6%. The Federal Statistical Office data are slightly older than this survey, and online banking figures for the population as a whole may have risen to our sample level in the intervening period. The apparent gender imbalance of the sample, with more males than females, was seen to be less of a problem in the context of current usage of mobile phones. One study reported that smartphones are more likely to be adopted by men than women, with 69.9% of all smartphones in Germany being owned by men, and 30.1% by women (comScore M:Metrics, 2008). In addition, 57% of online banking users in Germany are male (Meyer, 2008).

Measurement
The constructs used in the questionnaire were adapted from prior studies in this field. In these past studies, all items have been found to show internal reliability, convergent and discriminant validity. In particular, TAM has been shown to be valid for examining online and mobile technologies in previous studies (Davis, 1989; Doll *et al.*, 1998; Luarn and Lin, 2005). All items in our research were measured by multiple items with the exception of 'Behavioural intention' and 'Overall risk'. A common criticism of the Technology Acceptance Model as frequently applied is its deterministic approach on the decision to adopt or reject a novel technology (McMaster and Wastell, 2005). This study instead takes a probabilistic approach in which behavioural intention is measured on a 5-point scale from "not very likely "to "very likely". In line with the study by Kim *et al.*

(2009) behavioural intention was measured with one item only on the basis that it was not a latent variable. Several other studies also limit the number of items measuring usage intention, see for example Cronin and Taylor (1992).

Perceived risk is a multidimensional concept. However, in the perceived risk literature, there is a lack of consensus how perceived risk should be measured (Dowling, 1986; Mitchell, 1999). In particular, the types/dimensions of risk perception vary from one situation to another, e.g. overall perceived risk could be measured on the basis of several dimensions such as security, privacy, performance risk (i.e. using a single measure on a 'riskiness' level), dimensions via multi-items (e.g. Stone and Gronhaug, 1993), or dimensions via multi-items and dual components such as measuring probability and importance of loss (e.g. Barkworth *et al.*, 2002). The researcher then has to decide how to combine the components, namely whether to multiply or add them for a risk score.

Several studies have shown that although conceptually the various risk dimensions are distinct, some are highly related and are often combined as a single measure (e.g. Jacoby and Kaplan, 1972; Kaplan et al., 1974; Mitchell and Greatorex, 1993). Furthermore, when examining unfamiliar technologies, some risk dimensions are difficult for consumers to distinguish to give accurate and meaningful responses to the researcher. Thus an overall measure for perceived risk has been applied in this research and the item was adapted from Featherman and Pavlou (2003).

Items for 'Perceived ease of use' and 'Perceived usefulness' were adapted from the original TAM presented by Davies *et al.* (1989) and from Luarn and Lin's (2005) m-banking acceptance model. These measures have been used in a number of studies of technology adoption. The construct of 'Compatibility' was based on the study by Wu and Wang (2005). The 'Trust' scale was adapted from McKnight *et al.* (2002) and Palvia (2009). 'Perceived credibility' was taken from Wang *et al.* (2003) to indicate a user's beliefs in the security and privacy protection provided by m-banking. 'Perceived cost' and 'Behavioural intention' were taken from Luarn and Lin (2005). Five-point Likert-type scales were employed with anchors ranging from 1 (strongly disagree) to 5 (strongly agree) for all questions, except for the items measuring perceived overall risk, which ranged from 1 (not at all risky) to 5 (very risky), and intention to use m-banking, which ranged from 1 (very unlikely) to 5 (very likely). All the items were modified to make them relevant within the context of m-banking and are listed in the Appendix.

Since young consumers in Germany are the focus of this study, the questionnaire was translated using back translation which is the most common form of proving the accuracy of translations in marketing studies (Douglas and Craig, 2007). The questionnaire was translated into German; and then back translated. To validate the instrument it was pretested after the translation for comprehension, clarity, and coverage to make sure that the respondents clearly understood the meaning.

The Structure Equation Modelling (SEM) approach was applied as it tests hypothesised causal relationships among multiple variables simultaneously (Anderson and Gerbing,

1988) and estimates the strength of interrelationships between latent constructs (Gallagher *et al.*, 2008). The data were analysed using AMOS Version 16 with Maximum Likelihood estimation. SEM allows the researcher to build, test and confirm models of complex relationships. and comprises two sub-models: a "Measurement Model" that allows the user to assess how well the observed variables represent the latent, unobservable constructs that they are hypothesized to measure; and a "Structural Model" that allows the user to estimate the strength of interrelationships amongst those unobservable or latent constructs. We have followed the two-step procedure of SEM by firstly examining scale validity from the measurement model using Confirmatory Factor Analysis (CFA) and secondly focusing on testing the proposed hypotheses using the structural model. Measurement reliability and validity of the model containing the multi-item constructs were assessed using CFA. Two items (Compatibility 3 and Cost 2) were deleted due to low loading estimates of below 0.5 (Bollen, 1989).

Table 2 displays the chi-square/degree of freedom ratio, as well as a number of goodness of fit indicators. The chi-squared divided by the degrees of freedom ratio for the measurement model was 1.82 and thus within the recommended range of 1 to 3 (c.f. Carmines and McIver, 1981). Furthermore, the CFI, GFI and IFI values were all above 0.9 and the RMSEA value was below 0.08 indicating an acceptable fit (c.f. Bentler and Bonett, 1980; Steiger, 1989). Based on these indicators, the measurement model demonstrated an acceptable fit with the data collected.

Table 2: Overall model fit indices of CFA for convergent validity

Model Fit Indices	CFA Model
Chi-Squared (χ^2)	107.142
Degrees of Freedom (Df)	59
χ^2/df	1.816
Probability Level (p)	0.000
Number of observations	155
Comparative Fit Index (CFI)	0.969
Goodness of Fit Index (GFI)	0.912
Incremental Fit Index (IFI)	0.970
Root Mean Squared Error of Approximation (RMSEA)	0.073

Convergent and discriminant validity were assessed. All factor loading estimates measuring the same constructs for the CFA model are highly significant ($p \le 0.001$) showing that all indicators effectively measure their corresponding construct and support convergent validity. Furthermore, the standardised loadings are all above 0.5 with the majority being above 0.7. The variance-extracted estimates and the construct reliabilities are shown in Table 3. The variance-extracted estimates exceed the 50% rule of thumb suggesting that the hypothesised items capture more variance in the underlying construct than that attributable to measurement error.

The reliability of the constructs was assessed using the measure of construct reliability (CR), which is computed from the squared sum of factor loadings and the sum of error variance terms (Hair et al., 2006). As shown in table 3, construct reliabilities range from 0.81 to 0.91 and thus exceed the threshold of 0.7 demonstrating adequate reliability (Hair et al., 2006). Taken together, the evidence supports the convergent validity of the measurement model. Discriminant validity was examined by comparing variance extracted measures with the inter-construct squared correlations associated with that factor (Lim and Teo, 1997). Table 3 shows that all variance-extracted estimates are greater than the corresponding inter-construct squared correlation estimates, thus confirming discriminant validity.

Table 3: Inter-construct correlation estimates

Construct	No. of items	CR	Comp	PU	PEU	Cred	Trust
Compatibility (Comp)	2	0.89	**0.81**	0.49	0.10	0.24	0.02
Perceived Usefulness (PU)	4	0.90	0.70	**0.70**	0.22	0.21	0.01
Perceived Ease of Use (PEU)	2	0.80	0.31	0.47	**0.67**	0.05	0.06
Credibility (Cred)	3	0.91	0.49	0.46	0.23	**0.76**	0.35
Trust	3	0.81	0.14	0.11	0.25	0.59	**0.59**

Note: Values in the diagonal represent the variance extracted; below the diagonal are inter-construct correlation estimates between the measured constructs; values above the diagonal are squared inter-construct correlations.

Results

The analysis began with exploratory descriptive statistics with regard to intention to use m-banking. An independent samples t-test was used to assess if males and females differed significantly with regard to their intention to use m-banking. Men were significantly more likely to use m-banking than women (means of 2.73 to 2.27; t=2.02; p≤0.045). This is consistent with the findings of Chau and Hui (1998) who found comparable results in their study of early adopters of new IT products. Furthermore, users of smart phones were significantly more likely to use m-banking than those who use other mobile phones (mean of 3.37 to 2.39, t=3.49, p≤0.001).

The effects of respondents' current frequency of online banking usage on their likelihood to adopt m-banking services were explored using ANOVA (f=17.05, df=2, p≤0.000). It was revealed that a significant difference exists between people who use online banking at least three times a month (mean=3.08) and respondents who use it either never or just sometimes (means=1.80 and 2.05, respectively). This result supports the view of Lee *et al.* (2007) as it shows that people who often use online banking are also more likely to adopt m-commerce than others.

We tested the proposed conceptual model using SEM. An inspection of the goodness of fit indicators demonstrated an acceptable fit for the structural model. The results for the structural model are presented in figure 2. All the paths are significant with the

exception of the determinants from perceived costs, perceived ease of use, trust and credibility to behavioural intention, which were not significant.

The proposed model explains 65.1% of the variance in intention to adopt mobile phone banking which is higher than the value of 40% in typical TAM studies (Venkatesh and Davis, 2000). Perceived usefulness had a significant effect on intention to adopt mobile phone banking (β=0.394, $p≤0.001$). Other significant indicators for the likelihood of adopting m-banking are compatibility (β=0.385, $p≤0.001$) and perceived risk (β=-0.185, $p≤0.001$). These results are in line with previous research (see Chen, 2008; Wu and Wang, 2005).

Figure 2: Standardised theoretical path coefficients
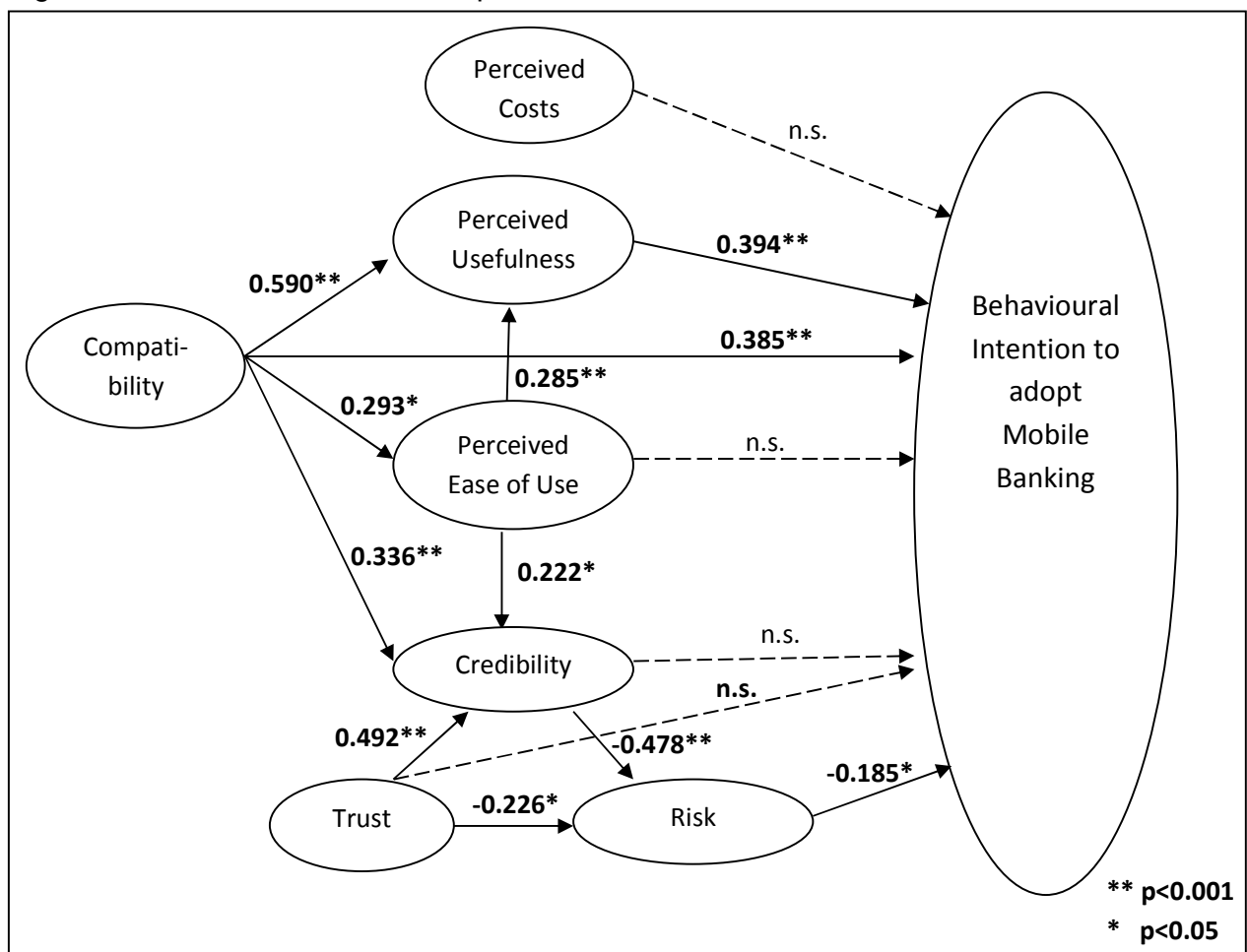
(Dotted line denotes non-significant relationship)
Model Fit Indices: χ^2 =147.003, df =94; CFI=0.971, GFI=0.905, IFI=0.971, RMSEA=0.061

Compatibility and perceived usefulness exert a direct positive effect on behavioural intention. There is also a strong relationship between compatibility and perceived usefulness (β=0.590, $p≤0.001$). Furthermore, compatibility positively influences

perceived ease of use (β=0.293, *p*≤0.05) and credibility (β=0.336, *p*≤0.001). Therefore people who assess m-banking as fitting in with their lifestyle and find it a suitable solution are also very likely to find it a useful service, which is easy to use and trustworthy.

Trust has a significant effect on credibility, i.e. security and respect for privacy in the channel (β=0.492, *p*≤0.001). As m-banking is an innovative service, users will not have a great deal of experience when judging the risk, thus non-mobile experience might influence their assessment of perceived risk (Kim *et al.*, 2009). Furthermore, it is interesting to note that credibility had a stronger negative significant influence on overall perceived risk (β=-0.478, *p*≤0.001) than trust (β=-0.226, *p*≤0.05). This means that people who demonstrate trust in their bank, mobile phone manufacturer, and/or service provider perceive less overall risk of using m-banking. However, protection of security and privacy for the user, i.e. credibility is more important than trust in reducing the perceived overall risk of using m-banking. Perceived ease of use positively affects perceived credibility (β=0.222, *p*≤0.05). This finding is consistent with Wang *et al* (2006; 2003) and Luarn and Lin (2005).

This paper could not prove that costs, ease of use, credibility, or trust have a significant direct effect on respondents' intention to adopt m-banking. These results partly confirm Luarn and Lin's study (2005) which found that perceived usefulness significantly affects m-banking adoption. Their study claimed that costs, credibility and ease of use also have a significant effect on behavioural intention. However, these results could not be confirmed. In contrast, the results of this research are consistent with Pikkarainen *et al.* (2004) who found in their study about online banking that ease of use had no influence on usage intention whereas perceived usefulness has a significant effect. Wang *et al.* (2006) state that perceived ease of use will depend on an individual's expertise with more experienced users finding it easier to use. Other TAM studies (e.g. Davis, 1989; Davis *et al.*, 1989; Venkatesh and Davis, 2000) have concluded that ease of use has less impact on technology acceptance than usefulness; this is because ease of use impinges on technology acceptance through perceived usefulness (Pikkarainen *et al.*, 2004). This indirect effect can be explained from situations where all factors are equal; in this case, the easier technology will be used (Davis, 1989; Venkatesh and Morris, 2000). Furthermore, the finding that compatibility and risk are of significant importance is consistent with other research (Aldás-Manzano *et al.*, 2009; Sivanand *et al.*, 2004; Wu and Wang, 2005) which emphasise compatibility and risk as key barriers for the adoption of m-commerce.

Although the hypothesis that credibility significantly affects the intention to use m-banking has not been confirmed, 54.2% of respondents thought m-banking would be associated with unauthorised divulging of personal information. Moreover, 57.4% did not agree with the statement that m-banking is secure in conducting transactions and 47.1% would find m-banking insecure in requiring and receiving other information, e.g. bank statements. This is consistent with Chen's (2008) study on m-payment which found that respondents were very much concerned about privacy and security issues. As credibility exerts a strong negative significant influence on overall perceived risk

(β=-0.482, p≤0.001), it can be concluded that credibility indirectly effects the behavioural intention of adopting mobile phone banking via the mediated variable 'risk'.

Discussion and Conclusions

The results of this study have implications for researchers and practitioners. For researchers, this study provides a basis for further refinement of models of consumer adoption. For practitioners, understanding the key constructs in the proposed research model is crucial to design and implement m-banking services that yield high consumer acceptance.

Firstly, in terms of academic theory development, the proposed model explained 65% of the variance in intention to adopt mobile phone banking which is higher than the value of 40% found in typical TAM studies (Venkatesh and Davis, 2000). Partial support was found for the first two hypotheses, which sought to validate previous research. Perceived usefulness and compatibility have featured in previous applications of the technology acceptance model and consistent with previous studies, were found in this study to have a significant effect on behavioural intention. Compatibility has the strongest positive influence on consumers' intention to adopt m-banking, followed by perceived usefulness. However, it had been expected that perceived ease of use would have an effect on behavioural intention, but this hypothesis was not supported in this study. The only effect was an indirect effect, mediated through perceived usefulness.

This study then sought to add the variables of risk, trust and credibility to a predictive model of intention to adopt a new technology. Risk had a significant negative effect on intention to adopt, but no significant direct effects of trust and credibility were observed. The significant effect of risk confirms previous research based on users' attitudes towards Internet services (Chen, 2008; Polasik and Wisniewski, 2009) and reflects respondents' unfamiliarity with the technology. Although risk was measured here as a unidimensional concept, further probing would be needed to identify the sources of this risk, and the extent to which it reflected a highly undesirable outcome, and/or a high probability of that outcome occurring.

It was noted that approximately half of all respondents feared that m-banking might result in their personal information being divulged in a way that breaches their privacy. However, credibility had no significant effect on behavioural intention. This may be explained by the fact that customers have difficulties in directly evaluating an Internet site's security/privacy (Wolfinbarger and Gilly, 2003). Trust had no direct effect on behavioural intention, although it did have an indirect effect mediated through risk and credibility. The problem of measuring trust is the multidimensional nature of the construct, and the problem of ambiguity about whether respondents are identifying with trust in a bank, trust in the telephone carriers, or trust in any other third party involved in delivering a web based service.

This study has given new insights into the importance of compatibility, which had significant direct and indirect effects on behavioural intention. The extent to which innovative products fit with the social structure and technological infrastructure of an

individual has been inadequately addressed in previous studies of adoption. This study has shown the importance of consumers' evaluations of the extent to which a new technology will be compatible with their lifestyle and familiarity with established technologies. It demonstrates that if consumers perceive m-banking as consistent with their existing beliefs, values, lifestyle and past experience, they are more likely to use these services. A further contribution of this study is that in addition to this direct link, we established that young customers are more likely to find m-banking services easy to use, useful and credible, i.e. free of security and privacy threats if they have positive beliefs about the compatibility of this new technology. Thus compatibility has been shown to be an important addition to the TAM model in the context of m-banking.

Perceived costs had no influence on behavioural intention. Previous research evidence on the effect of costs has been mixed, and the lack of a significant effect in this study may have reflected respondents' ambiguity over the distinction between actual costs of purchase and use, and hidden transaction costs. A questionnaire based methodology in itself is not highly suitable for assessing responses to price, unless respondents are presented with more specific information about the actual price of the products on offer, and the price of competing products. This information was not presented in this study and further analysis of the effect of price may be derived through scenario based or quasi experimental frameworks. This study has supported previous research into technology adoption that for market segments of early adopters, price is not an important influence on their decision to adopt.

There are a number of implications of this study for the banking sector. In terms of behavioural and demographic data, the study has identified segments of individuals who are most likely to adopt m-banking. Males are more likely to be early adopters than females. A higher likelihood of adopting was also expressed by those who use smart phones and those who are already online banking users. It should logically follow that one strategy to increase the uptake of m-banking is for banks to increase the numbers who use online banking. This may be seen as a means of reducing risk and improving the credibility of electronic means of banking in general.

Banks should focus more on managing belief formation of consumers than on directly influencing behavioural intentions. These internal psychological processes will then result in the intended behaviour. Banks must educate consumers about the usefulness, convenience and advantages of m-banking. Significant effects of, compatibility, and ease of use on perceived usefulness have been observed. The observation that compatibility had significant direct and indirect effects on intention to adopt m-banking has a number of implications for banks. Young consumers in Germany expect m-banking services to be compatible with their everyday life. In particular, companies have to emphasize that m-banking fits with young consumers' lifestyles and that m-banking would work on their mobile phones. Banks need to gain a thorough understanding of the ways in which m-banking could be perceived as being useful, given the significant direct effect of perceived usefulness on intention to adopt.

To achieve this, a detailed understanding of the lifestyles of young people -the key adopter group- is most likely to be gained through anthropological studies. A report by Juniper, for example, highlighted how a mobile phone has become an essential part of a lifestyle of "generation Y" people and reported that many young people would not leave home without their mobile phone (Wilcox, 2009b). For example, around 86% of young people aged between 15-39 reported that their mobile phone was an important part of their daily lives (Eurostat, 2007). Another study suggested that more than 60% of Germans under 29 (45% of 30-39 year olds) could not imagine living without their mobile phone (Meyer, 2007). In much the same way as young people now habitually use mobile phones to access their social networks, the same may be come true of m-banking. A mobile phone which was initially seen by this group as useful for making calls, and then useful for sending messages through their social network sites, may eventually be seen as useful for undertaking financial transactions. Without a mobile phone, this group may feel isolated from its social networks. Over time, the lack of a mobile phone may leave this group feeling isolated from its financial resources. If consumers get used to paying with their phone (phone as wallet) then m-banking will be seen as increasingly useful. Jupiter research has estimated that by 2011 mobile phone payments globally will have reached USD 22bn (cited in Meyer, 2007).

Perceived risk emerged as having a significant negative effect on intention to adopt, and banks must seek to reduce this perceived risk, for example by offering specific service guarantees protecting adopters from harmful consequences of service failure. There is evidence that guarantees can act as, a risk-reducing attribute as it is an indicator that the firm takes complaints seriously (Lidén and Skålén, 2003). As an example, it is reported that Huntington Bank offers an explicit Online Banking Guarantee which promises to replace funds a customer did not authorize to be withdrawn from an account (Huntington Bank [Online], 2009). Besides service guarantees, trial periods can also reduce the perceived risk associated with services (Daniel and Storey, 1997). Chen (2008) recommends developing more sophisticated authentication schemes such as biometrics to protect users to overcome problems of credibility. Although this study could not provide evidence that trust directly affects the intention to adopt m-banking, trust remains important in the relationship between banks and customers. As this study has shown, trust has an important effect on perceived risk.

This research has a significant limitation shared by many studies of consumer adoption in that it only measured behavioural intention, rather than actual behaviour. There is mixed evidence of a link between intention and behaviour with some researchers reporting a close correlation (e.g. Fishbein and Ajzen, 1975; Venkatesh and Davis, 2000; Venkatesh and Morris, 2000), while others have reported a weak link, for example Wang *et al.* reported that "behavioural intentions are only partially useful as their correlation with actual behaviour is low and mediated by many other variables" (Wang *et al.*, 2006, p.175). Although risk had a significant negative effect on intention to adopt, the single item measure of risk may not have captured the multi-dimensional complexity of risk.

This research has focused on young consumers in Germany. The case was made for specifically studying this group, because people in this group have tended to be early adopters of new products in general, and over time, products adopted by this group are likely to be subsequently adopted by older groups. Nevertheless, the findings of this study can only be generalised in the first instance to people of this age group. There is also a limit to the extent to which the results can be generalised from Germany to other countries. The level of trust and perceived risk, for example is dependent upon the quality of the technological infrastructure, the legal framework, and the reputation of specific phone companies and businesses in general. Where these variables are different, trust and risk may become more or less influential as factors influencing consumers' intention to adopt.

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Appendix 1

Perceived usefulness

PU1   Using mobile banking would make it easier for me to conduct transactions, standing orders etc.

PU2   I would find mobile banking useful in conducting transactions, standing orders etc.

PU3   Using mobile banking would make it easier for me to get information such as bank statements.

PU4   I would find mobile banking useful in getting information such as bank statements.

Perceived ease of use

PE1   Learning to use mobile banking is easy for me.

PE2   It would be easy for me to become skilful at using mobile banking.

Perceived credibility

Cred1   Using mobile banking would not divulge my personal information.

Cred2   I would find mobile banking secure in conducting my transactions.

Cred3   I would find mobile banking secure in requiring and receiving other information, e.g. bank statements.

Trust

Trust1   I would trust my bank to offer secure mobile banking.

Trust2   I would trust my mobile phone manufacturer to provide a mobile phone which is appropriate for conducting mobile banking.

Trust3   I would trust my telecommunication operator to provide secure data connections to conduct mobile banking.

Compatibility

Comp1   I believe that using mobile banking will fit my lifestyle.

Comp2   I believe that using mobile banking is suitable for me.

Comp3   I believe that my mobile phone is compatible with mobile banking technology.

Costs

Costs   It would cost a lot to use mobile banking (e.g. buy a new mobile phone)

Overall risk

Overall_Risk   On the whole, considering all sorts of risks combined, about how risky would you say it would be to sign up for and use mobile banking?

Behavioural Intention

MB_Usage   Assuming that you have access to mobile banking services, how likely is it that you will use it?