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The adoption of mobile services: A cross service study

by

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PREFACE

This report is part of a coordinated initiative of two projects funded by the Research Council of Norway, Telenor, Den Norske Bank, A-Pressen, Ericsson and EasyPark at SNF. The main purpose of the coordinated initiative is to provide evaluation frameworks that may be used by service providers to understand the behavioral requirements of end-users adopting mobile and channel integrating services. As part of the initiative, surveys studying the adoption of general mobile commerce services, text messaging services, mobile payment services, mobile gaming services and mobile contact services have been conducted. This report presents the common adoption model used in all studies and reports the individual results of the study of text messaging, contact services, payment services and gaming services. It also compares the models across studies to investigate if service specific adoption requirements can be found. The report is mainly written by Professor Per E. Pedersen, but contributions from Associate Professor Herbjørn Nysveen and Research Scholar Helge Thorbjørnsen have also been integrated. I also want to thank Senior Researcher Rich Ling at Telenor R&D and Professor Leif B. Methlie at the Foundation for Research in Economics and Business Administration for valuable comments on theory, models and findings.

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ABSTRACT

This report extends previous research on mobile service adoption from SNF (Pedersen, 2001, 2002). It is based on a modification and re-specification of the theory of planned behavior and includes analysis of the motivational, attitudinal, social and resource-related influence on adopters' intention to use mobile services. In particular, we report how these influences differ across service categories and to some extent user segments.

The adoption model is tested with empirical data on users' adoption and intention to adopt four different mobile services selected to represent different service categories. Traditional text messaging services and contact services are selected as representative communication services and gaming and payment services are selected as representative information services. The common model is estimated for each of the four services, and the results common to all services can be summarized as follows:

- The adoption models show good fit and explanatory power.
- The motivational influence is dominated by the direct influence of intrinsic (enjoyment) and derived (expressiveness) motivations
- Extrinsic motivations of usefulness are context specific
- Social influence is less influential than originally proposed
- Attitudinal influence is less influential than originally proposed
- Resource-related influences are generally important

The general influence of enjoyment and expressiveness as operations of intrinsic and derived motivations is most consistent. Even for services aiming

specifically at utilitarian gratifications, the motivational influence of enjoyment and expressiveness is strong and consistent. A surprising finding is the lack of support for a strong social influence on the adoption of mobile services. This indicates that social norms of relevance to mobile services may exist (such as the norm that one should have a well developed social network), but no direct norms of mobile service use can be found that significantly influence the intention of users to adopt specific mobile services. Several service specific findings are also reported. These findings generally support our proposition that adoption models differ across service categories. For an overview of these findings, we refer to section 5.

Our results show that there are no simple relationships between the differences in mean values of perceived constructs across services and their influence in the adoption model of each particular service. This implies that attitude surveys or usefulness studies should focus on the relationships between perceived constructs rather than comparing perceptions on individual constructs across services. These findings also indicates that the complexity of end-users adoption models, particularly of their motivational and attitudinal processes, is high, and that service specific and segment specific models should be developed that help developers and service providers in their adoption requirement evaluations. Even though the external validity of our results is limited, the model contributes to an improved understanding of the adoption requirements of mobile service users.

1. INTRODUCTION

Telecommunication operators have recently made large investments in new infrastructure for mobile data communication. To pay back the investments made in network and service infrastructure, new end-user services based upon data rather than voice traffic should be developed, distributed and adopted. To obtain widespread adoption of these services, a set of requirements should be met. These requirements are technological, business strategic and behavioral (Pedersen, 2002). First, complex services require an integration of network technologies and network-, content- and supplementary services. Second, adoption on the demand side requires widespread adoption of technology and service platforms among application developers and service providers. Finally, end-users implicitly specify a set of demand-side requirements that the services should meet. To understand these requirements, analyses of the context specific behavior of end-users should be conducted. These behavioral, demand-side adoption requirements are the focus of this report.

Understanding behavioral adoption requirements is important to both researchers and industry players. For researchers, an important issue is how mobile end-user services differ from traditional ICT-services in ways that affect their adoption. For example, the personalization, location specificity and ubiquity of these services are suggested as important characteristics making their adoption different from other ICT-services (Rask and Dholakia, 2001). However, with the introduction of 2.5 and 3G services, a convergence is expected of mobile and traditional Internet based services. Consequently, much of what has already been learned from studies of the adoption of traditional Internet services may be relevant to understanding the adoption of future mobile services. In addition, research on the adoption of simple services like text messaging and simple SMS-based services may also provide important

insights into understanding the adoption of new mobile services. From the perspective of industry players, understanding the process by which these services are adopted is important. Three research questions are of particular interest: What services of this kind are likely to be adopted by end-users; how does the end-user decide to adopt these services; and what influences that adoption decision. Of these questions, the last two are focused in this report, but we also discuss issues of relevance to the first. In addition, it is also likely that by investigating the two last questions, it may be possible to suggest what kinds of services are likely to be adopted under specific conditions.

To investigate these questions, we suggest combining theories and models of traditional ICT adoption research with findings from behavioral studies of mobile service adoption. Traditional Internet-based services are typically studied applying diffusion and adoption research perspectives. These perspectives are not often applied to studies of the adoption and use of mobile services. Instead, a uses and gratifications or a domestication research perspective is typically applied (Leung and Wei, 2000; Haddon, 2001). Uses and gratification research has a long history in communication research and has been applied to understand the gratifications sought by users of a wide variety of media. Recently, this perspective also includes studies of the gratifications of new communication media such as chat services, pagers and text messaging services. Even though domestication research studies typically focus the consequences of mobile service adoption and use, these studies also suggest relevant ways in which traditional adoption models may be extended and modified to better explain the adoption of mobile services. In this report, we suggest using uses and gratifications and domestication research findings to extend and modify the decomposed theory of planned behavior (Taylor and Todd, 1995). The model is applied in four empirical studies of mobile service adoption.

1.1 Problems and approach

This study focuses three issues in the adoption of mobile services. The first issue is the relationship between motivational, attitudinal, social and resource-based influences on the adoption of mobile services. For example, because many mobile services are communication services, one may expect social influence on the adoption decision to be strong. The motivational process may also be driven by the users seeking other gratifications of mobile services than of traditional ICT-based services. Furthermore, mobile services are often new and unexplored services indicating that the intention to adopt a service may be attitudinal rather than experiential. To investigate the relationship between these influences on adoption, a rather comprehensive model should be applied. As far as we know, only traditional adoption research (e.g. Taylor and Todd, 1995) and research on media use and choice (e.g. Trevino et al., 2000) have developed and tested such comprehensive models. For example, in uses and gratifications research, the primary influence of intention to adopt a service is believed to be motivational and is found in the gratifications sought by adopters. In domestication research, most of the suggested explanations of adoption behavior assume that attitudinal and social influences are the most important.

The second issue we focus is that the relationship between motivational, attitudinal, social and resource influence may differ across categories of services. For example, the gratifications obtained from payment services may be very different from those of gaming services. Consequently, the motivational influence on the adoption of these services may be different as well. Likewise, mobile communication services are important services for maintaining users' social networks, and consequently, social influence may explain their adoption while not being influential in explaining mobile information services adoption.

Finally, mobile services may differ in requiring more or less skills and experience of their users, indicating that resource-based influence on the adoption process may differ across service categories as well.

The third issue we focus is that the relationship between influences is also likely to differ across user segments. For example, domestication studies have revealed how young users are influenced by fashion and expressiveness in their motivation to adopt mobile services. Domestication studies have also identified gender differences in the use of mobile services, and these differences are also likely to be reflected in differences in what influences the adoption decision of male and female users. Even though segment differences are not the primary focus of this report, we suggest it is likely that segment differences are service dependent. Thus, segment differences should be investigated in a thorough analysis of service category differences in the users' adoption models. Despite service and segment differences, we suggest that there are concepts and relationships that are important when explaining the adoption of mobile services that are different from the concepts and relationships typically applied in studies of traditional ICT adoption. For example, all mobile services include gratifications of availability and flexibility not traditionally sought in other ICTs. Furthermore, mobile services are used across the work/leisure boundary typically characterizing the user contexts of traditional ICTs. This suggests that the motivational, attitudinal, social and resource-based influences may share similarities within the category of mobile services that make their adoption process different from that of traditional ICTs.

Identifying the motivational, attitudinal, social and resource-based influences on adoption of mobile services requires the application of a somewhat comprehensive adoption model. Several options have been investigated, such as the technology acceptance model (TAM) of Davis (1989), the theory of

reasoned action (TRA) (Fishbein and Ajzen, 1975), the theory of planned behavior (TPB) (Ajzen, 1991), media richness theory (Daft and Lengel, 1985), social influence theory (Fulk and Boyd, 1991), symbolic interactionist theory (Trevino et al., 1987), and more comprehensive frameworks of media use such as that proposed by Trevino et al. (2000). Of these approaches, only the theory of planned behavior and the comprehensive model of Trevino et al. (2000) include all influences mentioned above. We have previously applied and modified the theory of planned behavior to explain adoption of mobile commerce services (Pedersen, 2001) and text messaging services (Pedersen, 2002). The results of these studies indicated that the theory of planned behavior needed modifications and extensions when being applied to mobile services, but the general fit and explained variances obtained when applying the model were promising. Consequently, we further investigate the limitations of this theory here in order to suggest modifications and re-specifications required to explain mobile service adoption. By applying a common basic model to the adoption of several service categories, focus may be set on the relevance of individual concepts in the model and differences in conceptual relationships of the model across service categories. This is particularly useful for operators and service providers offering a portfolio of services who are trying to understand what determines the adoption of these services in various user segments.

1.2 Characterizing services

To investigate the issues presented above, a cross service study was required. In comparing services, variance in service characteristics is necessary. To provide this variance, two criteria were set up. First, the services should represent both communication and information services. Second, the study should include services intended to meet utilitarian and extrinsic gratifications as well as gratifications of sociability, enjoyment and expressiveness. To meet these

criteria, the following services were included in this study: Regular text messaging services used to communicate person-to-person using mobile terminals, contact services used to initiate contact with persons not previously known or to chat with such people on topics of interest, payment services used to pay for products and services delivered through a variety of channels using mobile terminals, and gaming services used for downloading and playing games on mobile terminals or for playing such games online.

Text messaging services in the form of SMS have been one of the most successful mobile services recent years. Currently, SMS is used either for mediating person-to-person communication or for accessing mobile end-user services. Communication may also be mediated by services such as mobile chat or flirt services. Such services extend the use of SMS to one-to-many communication, and also make it possible to display and store messages on other media. Using Te'eni's (2001) categorization system of computer mediated communication, text messaging may be characterized as an interactive and adaptive messaging service applied in low capacity channels. While previous studies focusing on media richness suggest this type of mediated communication is useful for the performance of less equivocal tasks and the exchange of formal messages, recent research gives more mixed predictions. For example, it has been suggested that the low channel capacity is compensated by including more affective components in the message. This also leads to an adjustment of message content such as reduction of distribution and to low formality in content, something that is typically observed in behavioral studies of text messaging use (Kaseniemi and Rautiainen, 2002). Currently, 11 % of European operator revenue comes from SMS-traffic (The Register, 2002a). For example, operator revenues generated from SMS in Norway in 2001 were approximately NOK 1500 mill. (Nettavisen, 2002). Of this, almost 90% of SMS-traffic is person-to-person communication (MobileSpring, 2002),

while the proportion of revenue generated from person-to-person communication is somewhat less due to premium taxation of many SMS services. Thus, considerable operator and content provider revenues are now being generated from SMS services of different kinds. Understanding some of the mechanisms behind the adoption of these services, related to service content and distribution as well as to users' behavior, may be key issues in understanding the potential adoption of new mobile services in general.

One of the most popular services accessed using SMS-based text messaging has been *mobile contact services*. This form of services extends person-to-person text messaging by a mechanism for sharing messages. The mechanism may include some form of message display, such as a TV-screen, a web-page or a wap-page, or it may just redistribute submitted messages to the mobile terminals of the contact service subscribers. The main purposes of most contact services are to express opinions on issues or to get in contact with (new) people. Currently, three forms of mobile contact services have been most popular in Norway. By far, the most popular form of service is that including the TV-set as a message display area. Most of these services include elements of flirt or getting in contact without relating to any other subject in particular. The primary gratifications obtained form using these services are believed to be entertainment and sociability and the services have primarily been adopted by young users. The services may be used as an arena for continued person-to-person dialogue and physical meetings in ways similar to traditional chat services (ICQ, IRC). As far as we know, no studies have been done on the relationship between the gratifications sought by using these services and the gratifications obtained - such as the rate of physical contacts resulting from the use of these services. Another form of contact services is chat services related to a specific subject. These services may originate from traditional discussion forums on the Internet or they may be serviced by some broadcast corporation

(radio or TV). In Norway, radio and TV-programs including sports, political debate or reality shows have introduced this kind of service with success. These subject-related chat services are more oriented towards expressing an opinion (expressiveness as gratification) and have been adopted by user segments in all age categories. The final form of contact services is chat or flirt services redistributing messages within a chat room directly to subscribers' handsets. The chat rooms may be subject-related or be organized by user segments (male, female, gay, lesbian etc.) and most include elements of flirt or getting in contact with new people with similar interests as oneself. In Norway, almost all SMS-service providers including TV and radio stations, newspapers and mobile portal providers, offer this form of contact service. Often, the service has a regional user base so that people chatting or flirting may actually meet in person. A variant of these services includes location information, so that people chatting or flirting may know approximately where the other users are located. We do not know the revenues generated from contact services, but it is estimated that approximately 200-300 million NOK will be generated by SMS-based services in addition to the revenues generated from person-to-person SMS messaging (Telecom Revy, 2002).

Mobile payment services currently exist in four forms. Payments using overtaxed SMS-messages are most common, and are currently used for the payment of small amounts (typically 2-10 NOK) for services delivered to the mobile phone or on the Internet. Examples of such services are ringtones, logos and access to entertainment on the Internet. Payments using a purse on the mobile terminal have gained in popularity and have so far mainly been used as a substitute for SMS-based payments. However, the mobile purse may contain NOK 1000 and are now increasingly being used to pay for products and services with a price exceeding the NOK 10 limit typical of overtaxed SMS-based payments. Examples of such services are loading the subscribers' prepaid

account, mobile gambling and payments for physical services such as bus, train and cinema tickets. Currently, the dominant mobile purse solution in Norway is SmartCash offered by Telenor. Purse-based solutions may also be connected to an underlying payment infrastructure. For example, the SmartCash account may be linked with a credit or debit card account. In practice, this third form of mobile payment solutions represents a card based payment solution where the card has been replaced by a mobile terminal utilizing the same underlying payment infrastructure as the card. In Norway, DnB and Telenor currently offer the SmartPay solution as such a payment service. Another way to link the mobile terminal to an underlying payment infrastructure is to use the subscribers' telephone bill. Depending upon when content providers are being paid by the operator, this solution represents a credit or invoice based payment mechanism. For example, PayEx, a leading Norwegian Internet purse provider has offered a solution where payments made using the mobile terminal with PayEx are transferred to the users' phone bill. At the current stage of development, mobile payment solutions represent an emerging technology that is mainly used for services where there have not yet been established an existing payment infrastructure. Examples of such services are vending machine payments, payments for Internet content and services downloaded to the mobile phone. So far, mobile payments have not established a position as a substitute for existing payment solutions.

In addition to preinstalled or operating system specific installed games, three different standards are currently used for *mobile gaming*: SMS-games, WAP-games and Java-based games. SMS-based gaming has already started to catch on. For instance, Virtual Boyfriend/Girlfriend, a game created by Scottish Digital Brides, logs some 16,500 text messages daily (The Economist, 2002). The Finnish game-developer Codeonline, owned by giants like AOL Time Warner, Bertelsmann and Motorola, currently provide SMS-based versions of

e.g. “Who Wants to be a Millionaire?”, “Trivial Pursuit” and “ET-The Extra-Terrestrial” to 250 million users through 40 different mobile operators. Codeonline generated more than 50 million paid gaming transactions in 2001. In Norway, a wide selection of SMS-based games is available. One of the most profiled SMS-games to date is the Eiandri fantasy game, provided by TV2. Although WAP (Wireless Application Protocol) has not become a huge success in Europe, besides being the most hyped acronym in year 2000, many content providers are currently developing WAP-based games – believing that the adoption of GPRS and new billing models will launch the growth of WAP-services (Gaptime, 2001). Many of Codeonline’s games, such as “Who Wants to be a Millionaire?” and “Trivial Pursuit” are also available in WAP versions – in addition to the SMS versions. Other games, such as Tease and Mobilisation are only available when using a WAP browser. Java is used as a programming language allowing multi-platform applications to run on Java-enabled mobile devices. These terminals allow users to download games in the form of small Java-applications (midlets) to their phone, saving online traffic fees when playing the game. Interactive Java-games can be divided into three categories: Standalone, server-based and streamed games (Gaptime, 2001). All these games can either be downloaded from service providers or be preinstalled by the device manufacturers. Standalone games do not require a traditional network connection to function. However, standalone games are not limited to single-player games if played using IR or Bluetooth connections between players. Server-based games, on the other hand, can be either single- or multi player games. When playing server-based games, the user is connected to the server of the service provider. Accordingly, the players may interrupt a game and continue it the next day by uploading game data from the server hosting the game. The final category, streamed games, is using advanced video decoding systems for delivering audio and visual data from servers to terminals. These

games require a certain bandwidth. G-Cluster has been pioneering streamed data concepts in collaboration with Sonera (Gaptime, 2001, p.51). Java-enabled terminals are slowly emerging, and low-end Java-enabled phones have now been announced by most terminal vendors. Recently, several analysts have announced expectations that Java-based games in particular and mobile gaming in general will generate considerable revenue (The Register, 2002b). Because Java-based games are limited in the size of the application being run, operating system specific games for separate installation over wireless networks are also available. Currently, both mobile gaming portals and general mobile application portals offer a mix of operating system specific and Java-based games, but generally, the state of mobile gaming may best be characterized as emerging.

Of the four services used in this cross service study, text messaging and contact services represent communication services. The other two services, mobile payment and mobile gaming, may be characterized as information services. Two of the services, contact services and mobile gaming may be characterized as entertainment and expressiveness oriented services, while text messaging and mobile payment services may be characterized as services meeting utilitarian gratifications. However, the gratifications obtained from using these services are in no way limited to utilitarian gratifications.

In the following, we first introduce relevant theory on the adoption of mobile services. This theory is used to propose a model of mobile service adoption based upon the theory of planned behavior. Along with the model, propositions are presented on the relevant motivational, attitudinal, social and resource-based influences on users' service adoption in section 2.5. In section 3, the method applied in the empirical part of this study is presented and discussed. In section 4, we present the individual results on each of the four services

investigated here as well as the results of a cross-service comparison of adoption models. In section 5, we summarize our conclusions, discuss the limitations of our study, and suggest implications for the mobile services industry as well as for research.

2. THEORY

Four different traditions have been identified as relevant to understanding the adoption and domestication of mobile services. Diffusion research has its foundation in marketing and economics, and studies the aggregate diffusion or adoption of a technology or service in an industry, in a community or in society in general. Uses and gratifications research has its foundation in media and communication theory, and studies the gratifications sought by adopters of media of different kinds. Adoption and media choice research has its foundation in information systems research, and studies the adoption and use of information and communication technology in general and in organizations in particular. Domestication research has its foundation in sociology, and studies the adoption, use and domestication of technology in society with a particular focus on the societal consequences of technology domestication. In this section, the four traditions are briefly introduced[1]. A model integrating many of the relevant findings from the uses and gratifications, adoption and media choice, and domestication traditions is presented and discussed with reference to the four service categories studied - messaging, contact, payment and gaming services. Two of these services may be characterized as communication services and two as information services. Thus, the brief review focuses particularly on these two services categories.

2.1 Diffusion research

Diffusion studies of mobile services have classified adopters of mobile services as belonging to different categories (segments), such as early adopters, early majority, late majority, laggards and non-adopters. For example, Wei (2001) studied the socioeconomic characteristics of mobile phone laggards in Hong

[1] A more thorough review is given in Pedersen (2002).

Kong, Tjøstheim and Boge (2001) studied the demographic characteristics of early adopters of mobile commerce when compared to non-adopters, while Mante-Meijer and Haddon (2001) did the same for general mobile services like voice and messaging. Mante-Meijer and Haddon (2001) characterized adopters of messaging services in Europe as younger than adopters of voice services (30.5 vs. 42.2 years average), and found that the probability of adoption was lower among people living with partners and even lower for people with children. In general, it is also assumed that an individual's text messaging use decreases as the user gets older (see also Ling, 2001c) and that use of text messaging complements voice services for economic reasons (see also Karlsen et al., 2001). In Mante-Meijer and Haddon (2001), the general aggregate adoption rate of text messaging services among mobile phone users was estimated at 15%, and almost all these users were Internet users as well. More recent Norwegian data indicate that among teens, the aggregate adoption rate of mobile phones is approximately 95% (Ling, 2001c), and this rate is higher among female users than male users in the early teenage categories. Within this category of users, the aggregate adoption rate of text messaging services is approximately 96 % (Karlsen et al., 2001). In Norway, female users also use text messaging significantly more than men in all comparable age categories. In addition, the use of SMS for service access (e.g. personalization) is higher among male users, and thus, the difference in use of person-to-person text messaging (texting) is considerable between female and male users (Ling, 2001).

No published diffusion research studies have been identified on mobile contact, payment and gaming services. However, industry reports have applied the principles of diffusion research to estimate the potential market size of mobile services. For example, Gaptime Century has produced diffusion forecasts based partially on historical data, and partially on expected adoption patterns for

mobile services and -phones, on technological innovations, and on societal changes (Gaptime, 2001). Published diffusion studies are found on different forms of payments services. For example, Yoris and Kauffman (2001) modeled the diffusion of electronic bill payment and presentment technology (EBPP), and found diffusion theory should include network externality to explain the likely conflict between being an early adopter of an untested technology and a late adopter of mature technology. Furthermore, Plouffe et al. (2000) applied the perceived characteristics of innovating (PCI) model to investigate why a smart card payment trial in Canada had failed. Szmigin and Bourne (1999) applied the supply side characteristics of an innovation (Rogers, 1995) as a framework for discussing the adoption requirement of electronic cash. Even though their analysis is qualitative, they conclude that electronic cash seems to complement rather than substitute other payment instruments, and the authors suggest that "*marketing effort should be concentrated on identifying niche opportunities or bundling appropriate services*" (Szmigin and Bourne, 1999, p. 192). Also, aggregate adoption studies of the traditional versions of the services investigated in this report are found. For example, Antonides et al. (1999) studied the adoption of different payment instruments across 10 European countries. While many of these diffusion studies are relevant to understanding the content of some of the services we investigate in this report, their contexts are different from that of mobile communication technology and thus, their relevance is somewhat limited.

2.2 Uses and gratifications research

Of particular relevance to this report are the recent uses and gratifications studies of mobile services like voice and messaging. One may expect other gratifications to be sought from mobile voice services than traditionally sought from fixed telephony. Dimmick and Sikan (1994) identified three general

gratifications; "sociability", "instrumentality" and "reassurance" from fixed telephony before the widespread adoption of mobile phones. Leung and Wei (2000) stress that newer generations of mobile telephony introduce the telephone as a content medium as well as a communication medium. In general, seven gratifications were identified of mobile telephones; "fashion/status", "affection/sociability", "relaxation", "mobility", "immediate access", "instrumentality" and "reassurance". Thus, the traditional telephony gratifications were found, but in addition, gratifications related to fashion, relaxation and entertainment, flexibility and mobility were identified. Leung and Wei (1999a) studied the gratifications from information search by pager use among young users in Hong Kong and found three gratifying factors termed "information-seeking", "novelty" and "fun-seeking". In Leung and Wei (1999b), the general gratifications from pager use were identified as "sociability", "information seeking", "entertainment", "utility", and "fashion/ status". Thus, the gratifications of pager use were very similar to those sought from mobile phones, but the "fashion and status" gratification was found to be a very important gratification of pager use. Consistent with similar studies of instant messaging services, the "fashion and status" gratification was more important for light users of the pager services. In addition, the sociability gratification was more important to female users and entertainment was more important to adolescent users.

Höflich and Rössler (2001) have conducted the only uses and gratifications study focusing particularly on text messaging that we have been able to identify. Their study was done among 204 German mobile phone owners of age 14 to 18. They identified the following gratifications; "reassurance" (rückversicherung), "sociability" (kontaktpflege), "immediate access /availability" (verfügbarkeit), "instrumentality" (lebenshilfe) and "entertainment/enjoyment" (nutz-spaz). Thus, the gratifications were very

similar to those of the mobile phone identified above. Of these gratifications, only "instrumentality" significantly predicted the use of text messaging services. Use of text messaging was found to correlate positively with voice service usage, but was uncorrelated with email and text message flirting service usage.

From these studies we may conclude that the gratifications sought from mobile phones overlap and extend the gratifications sought from fixed telephony. Furthermore, the gratifications from text messaging services were found to be very similar to the general gratifications sought from mobile phone use. Thus, the reasons for choosing between text messaging and voice services can not be found in uses and gratifications research, but must be sought elsewhere. However, uses and gratifications research shows how the gratifications of text messaging and mobile phone use in general are different from the gratifications of the fixed telephone, and to some extent of email, but very similar to the gratifications sought by instant messaging. However, the similarity of text messaging, mobile phone use and instant messaging gratifications may be caused by bias in the user segments studied in uses and gratifications research, and may be gratifications sought by young users regardless of the media chosen.

In a study of college students' gratifications from using ICQ, Leung (2001) identified seven gratifications termed "express affection", "entertainment", "relaxation", "fashion", inclusion", "sociability" and "escape". These findings oppose the utilitarian gratifications identified by Dimmick et al. (2000) for email. They also suggest that traditional media gratifications like entertainment and escape are sought from messaging services, and indicate that users may seek different gratifications from different messaging services. Thus, different messaging services may be complementary and provide the basis for the use of

a cluster of functionally similar technologies among young users. Leung (2001) found that ICQ use was positively related to mobile phone and email use, supporting the hypothesis that young people adopt a cluster of functionally similar technologies and do not substitute the use of one service or technology for another. Leung (2001) also found that female users used ICQ more than male, and that they use ICQ for sociability reasons while male users use it more for relaxation and entertainment reasons. In a comparison of light and heavy users, heavy users were motivated by affection and sociability while light users were more motivated by fashion.

In a uses and gratifications study of video games, conducted by Sherry et al (2001), six different uses and gratifications were found: “competition”, “challenge”, “social interaction”, “diversion”, “fantasy” and “arousal”, were the most frequently reported reasons for using video games were challenge, arousal and diversion. Although the gratification of “social interaction” resembles “affection/sociability” (in Leung and Wei, 2000) and “diversion” approximates Leung and Weis' “relaxation”-factor, we observe that the gratifications of video games deviate from those of mobile phones on several aspects. Specifically, users of video games appear more focused on satisfying needs of competition, fun-seeking and entertainment than do mobile phone users, whereas mobile phone users put a larger emphasis on factors related to fashion, mobility and accessibility. Accordingly, we might expect mobile game users to particularly favor the “sociability” and “diversion/relaxation” gratifications of mobile games, although also appreciate the “competition” and “challenge” as well as the “mobility” and “accessibility” gratification of mobile gaming. We particularly expect the latter factors to be of importance given the typical user-situations of mobile gaming reported by Graham (2000). Graham (2000) studied the self-reported mobile gaming situations of Nokia users, and found that 24 percent reported “when waiting”, 22 percent “in cars”, and 12 percent

"on trains". Only 21 percent reported "at home". Accordingly, the vast majority of mobile gamers played these games outside the home, usually on the move and/or when waiting, and we assume "mobility" and "accessibility" to be important gratifications for mobile gaming when compared to traditional gaming. Sherry et al. (2001) found that challenge, fantasy and social interaction were the strongest predictors for the liking of imagination games and traditional games, whereas social interaction, arousal and competition were the strongest predictors for liking physical enactment games (such as shooting-, fighting-, and racing/speed games). Moreover, the results reconfirm the findings from gender research, stating that women prefer more quiet, intellectual challenging games such as puzzle and trivia games, whereas boys enjoy games that have more flashy graphics, require faster interaction and are more violent (Sherry et al, 2001, p.11). According to Sherry et al (2001), the observation that girls prefer puzzle- and trivia games is consistent with the socialization pressure girls often feel to play quiet, non-violent games. If this is true, it may indicate that subjective norm is a stronger determinant of mobile gaming adoption for girls than for boys.

2.3 Information systems research

Few studies are found on the use of mobile telephony services in general in IS-research (for a few exceptions see Hinds and Kiesler, 1995; Manning, 1996). There are even fewer studies applying adoption research models to mobile services or telecommunication services in general. However, some studies have been identified applying adoption models to explain the intention to use telemedicine applications. For example, Hu et al. (1999) suggested that the technology acceptance model (TAM) may be too parsimonious when being applied to explain the adoption of such specific technologies as telemedicine applications. The model showed good fit and reasonable explanatory power

when explaining intention to use, but was only able to explain 37 % of the variance in attitude towards use. Thus, Hu et al. (1999) suggested incorporating additional explanatory factors in the TAM model when applied to health-care contexts. Of interest to the payment studies investigated in this report is a study by Plouffe et al. (2001a) comparing the TAM model to the perceived characteristics of innovating model (PCI). Even though this study focused the adoption requirements of merchants - not consumers, the study showed that the PCI model explained more of the variance in intention to adopt the payment system than the TAM model. Plouffe et al. (2001a) concluded that the TAM model may be too parsimonious and could successfully be supplemented and extended using the more operational concepts of the PCI-model, such as compatibility and image (se also Plouffe et al., 2001b). Kwon and Chidambaram (2000) applied the TAM model to explain the general adoption of mobile phones among regular subscribers in a metropolitan area in Hawaii. They also suggested the TAM model could be extended, and included social pressure as an additional variable. Somewhat surprising, the authors did not find support for the social pressure variable, and contrary to many other studies applying TAM, they found that ease of use was perceived to be more influential than usefulness in explaining intention to use. Pedersen (in press) applied the TAM model to explain the intention to use mobile commerce services. He found that the TAM model should be extended. However, the main improvement in explanatory power was obtained by extending the model into a modified version of the theory of planned behavior (TPB) and not in the isolated inclusion of subjective norm as a measure of social influence. Based upon these few studies applying adoption research to mobile phone contexts, results are mixed. However, all studies indicate that the original TAM model needs to be extended when being applied to explain the adoption of devices and services in this context. This was also supported in a study of mobile commerce

services by Pedersen (2001). He found that the TAM model should be extended with variables including subjective norm and behavioral control and suggested applying a modified version of the decomposed theory of planned behavior. The model was tested empirically, and the model explained 49% of the variance in intention to use mobile commerce services. Intention to use was mainly influenced by attitudes towards use, subjective norm and behavioral control. No direct influence was found of usefulness on intentions to use these services.

In computer-mediated communication research (CMC) and research on media use and choice, there has been little focus on mobile services. However, some studies now exist on the use of messaging services and chat services. In a study trying to integrate contexts often separated in research on mediated communication (work, learning, community and leisure), Haythornthwaite (2001) studied the use of email, discussion forums and IRC in a distance learning class. Even though the study focused social network analysis, some findings were reported on media use. Discussion forums were used as a forum for diffuse, background information exchange in one-to-many communications. IRC was used for class-wide communication, but "*more to named others*" (Haythornthwaite, 2001, p. 221). Over the period of the study, use of IRC increased, while person-to-person email communication decreased. However, email was the most frequently used medium and was used in particular for intrateam communication. Haythornthwaite (2001) concludes that "*email emerges as important for strong, project-oriented ties, and the Webboard and IRC for weaker class-wide ties*" (p. 222).

Users seem to combine messaging services with other forms of mediated communication as well as with other messaging services. For example, text-messaging services are cognitively lightweight services that may be combined in specific ways with more media rich and cognitively demanding services

(Churchill et al., 2000; Nardi et al., 2000). A number of studies have investigated the use of instant messaging services in workplace settings (e.g. Churschill and Bly, 1999; Churchill et al., 2000; Bradner et al., 1999). Most of these studies are usability-related, and are positioned in computer supported cooperative work (CSCW) design traditions rather than in CMC-research. However, some of them include references to CMC-research and some also include behavioral studies of message service use. Churchill and Bly (1999) found that users of a simple MUD environment did not require complex interfaces, but instead adapted their communication behavior to fit the simple messaging environment provided by the MUD-application. There were no requests for advanced awareness functionality, but the fact that some awareness functionality was available made the service popular. An interaction was also found between the primary use of the service and its adoption. The number of chat rooms with work-related focus increased as the number of social-related chats decreased, and adoption also increased with the number of work-related chats. Thus, user interactions make users "create their own services" from a service structure or application. Some of the elements identified as important for the success of the messaging service were: Prior knowledge of participants, services as complements to other tools, and organizational support. Segerstad and Ljungstrand (2001) found that a university wide messaging service was used to support both work and social activities, but that it was also extensively used for playful behavior. In another study of instant messaging in the workplace, Nardi et al. (2000) found that these services were used for the purpose of negotiating availability, sustaining social connections, switching media, and retaining context. Thus, the service functioned as an unattended awareness tool (availability, social connections and retaining context), and as a tool for switching media. The study also clearly showed how messaging services complemented other media, such as phone and email, at the workplace.

Another branch of IS-research of relevance to mobile services is research on computer mediated communication and human computer interaction based upon the theories of "teleprescence" and "flow". Telepresence can be defined as the extent to which a user feels present in a mediated environment (Steuer, 1992; Schloerb, 1995; Tamborini, 2000). Telepresence conceptualizes the degree to which users perceive that they are “physically present” in the virtual space of the computer-generated environment. The experience of telepresence involves consumer fantasy, imagination and suspension of disbelief, suggesting elements of fun and playfulness (Shih, 1998). The extent to which users experience telepresence can vary substantially as a function of individual differences in their susceptibility to experiences in various mediated environment, as well as situational differences and attributes of the medium and interface of the technology being used. Tamborini portrays the concept of telepresence to be more relevant and essential in gaming than for other media activities, because (video-) games have other involving qualities when compared to e.g. television. In order to control play in an electronic game, users are required to pay careful attention, to make mental maps of the environment, to note its objects and landmarks for future reference, and to coordinate visual attention with motor behavior (Tamborini, 2000, p.21).

Flow is a cognitive state experienced during various activities and is described as an “optimal experience” (Csikszentmihalyi, 1977) that is “instrinically enjoyable” (Privette and Bundrick, 1987). The concept of flow formalizes and extends a sense of playfulness (Csikszentmihalyi, 1977) in which consumers are so acutely involved in the interaction and task at hand that nothing else seems to matter and time may seem to stand still (Lutz and Guiry, 1994). According to Hoffman and Novak (1996), flow in computer-mediated environments (CME) is determined by 1) high levels of skill and control, 2)

high levels of challenge and arousal, 3) focused attention, and 4) is enhanced by interactivity and telepresence.

The research on the flow-concept is quite diverse, ranging from studies of human-computer interactions (HCI) (Csikszentmihalyi, 1990; Ghani, Supnick and Rooney, 1991) and Internet web usage (Novak, Hoffman and Yung, 2000; Hunter and Kalafatis, 2001) to flow experiences in relation to physical sports, such as athletics and football. Preliminary evidence also suggests that the psychological experience of gaming is consistent with the dimensions of the flow experience (Bryce and Rutter, 2001). According to Bryce and Rutter (2001), ethnographic observations of public gaming events and analysis of the online forums evolved around such competitions reinforce these findings. In these qualitative studies, gamers typically described themselves as "being in the zone" or "in the flow" of the game.

The studies of user flow and telepresence conducted in online environments (cf. Novak et al, 2000; Hunter and Kalafatis, 2001) may provide us with useful insights into potential determinants that may be used to modify existing adoption models to fit mobile service adoption. For instance, high levels of perceived enjoyment (Pedersen, 2002) would capture important aspects of flow – which is defined as an "optimal intrinsically enjoyable experience" (Novak et al, 2000). Further, Hunter and Kalafatis (2001) argue that the construct of "challenge" in the flow model is the opposite (inverse) of ease of use – which is a separate construct in most traditional adoption models (Pedersen, 2002). Moreover, the measures of "skill" in the flow model (Novak et al, 2000) resemble common operations of perceived self-efficacy (cf. Pedersen, 2002; Taylor and Todd, 1995; Bandura 1982).

2.4 Domestication research

The majority of studies on mobile services have been conducted in the field of domestication research. A more comprehensive review may be found in Haddon (2001), Pedersen and Ling (2003) and Pedersen (2001, 2002). In the work context, much previous domestication research has been conducted on the adoption of mobile services among knowledge workers (e.g. O'Hara et al., 2001), but recent work has also focused "blue collar" workers (e.g. Brodie and Perrie, 2001). Research contrasting work and leisure contexts has either focused directly on the functional use of mobile services in leisure and everyday contexts, or focused on how the boundary between work and leisure contexts is blurred by the use of such services. For example, Palen et al. (2001) studied the impact of mobile phones adopted for functional, work-related reasons (e.g. availability, flexibility), on the users' everyday life activities. These findings indicate that explanations of the adoption of mobile services should be investigated across work and leisure contexts.

Several domestication studies focus on gender differences in mobile end-user service adoption. An early study in this tradition was conducted by Rakow and Navarro (1993). Their work described interesting communication patterns, such as e.g. "remote mothering" among women. Rakow and Navarro asserted that, at an early point in the diffusion of the device, the mobile telephone was a device that replicated preexisting gender patterns, i.e. the role of the woman as an accessible nurturer and a person in need of male protection. Later, several studies have elaborated on gender differences in the adoption of both voice and other mobile services (e.g. Ling, 2001a, Ling, 2001c). The mobile telephone was earlier mainly seen as part of the male domain (Puro, 2002), but now the device has been redefined as a social network device and thus within the domain of women. For example, Skog (2002) observed that girls valued social

functionality of the mobile phone higher than boys, who on the other hand stressed technical functionality. She explained this finding with general *role theory* suggesting that text messaging is more functional in maintaining female roles, than male roles. This is also observed in the content differences of the text messages of girls and boys. For example, Kaseniemi and Rautiainen (2002) observed that girls more often used all 160 characters of an SMS and filled it with references and social gossip, while boys often wrote messages of 40-50 characters with "plain language". Both Ling and Yttri (2002) and Larsson (2000) describes a careful examination, interpretation and sharing of messages among and between female users (particularly teens) that may be explained by *attributes of the social networks* of female versus male users (e.g. female social networks being more comprehensive, open and everyday life as opposed to working life oriented). The channel richness, interactivity (asynchronous) and format of text messaging services may be particularly well suited for maintaining such social networks. The expressive use of mobile phones explained by theory of social identity and identification is common to both sexes, but is conducted in different ways by male and female users. Gender differences in using the mobile phone to express social identification has been explained by Larsson (2000) using rather general theory of *group identity formation* and by Skog (2002) using *image* theory and theory of *social classes*. Male users express their identity with technical attributes, such as brand name and model, while female users express their individuality and confirm their group identity by sending, receiving, filtering and sharing text messages.

A variety of explanations have been suggested of the widespread adoption of mobile services among young users. For example, it has been suggested that the adoption behavior can be explained by a "theory of fashion" (e.g. Ling, 2001b) wherein the popular characterization of the device seems to have changed with time, by the use of services as "ritual gift giving" (e.g. Taylor and Harper,

2001a), by treating the mobile phone as "symbolic capital" (e.g. Skog, 2002) or as an instrument in "family differentiation and symbol of individuality" (e.g. Taylor and Harper, 2001b), and by the use of services as a "group marker or social identifier" (e.g. Weilenmann and Larsson, 2000), or as a "self identifier" (e.g. Hume and Peters, 2001). Currently, these explanations should all be treated as tentative because none of them has undergone formal hypothesis development and confirmatory testing. However, they suggest important explanations that, when validated, will have to be integrated as parts of a more formal theory of mobile service adoption.

Most of these explanations have been applied in studies of young users' text messaging adoption. Even though text messaging was not explicitly focused by Ling (2001b), he indicated three conceptions of *fashion and style*, and suggested a development from style as display through style as communication to style as a means to integrate social networks. With these conceptions, the use of text messaging may be understood as both a way of communication and as a means of social integration that plays a role as style marker when the mobile phone itself has lost its significance as an object of style display. This is closely related to Skog's (2002) interpretation of the mobile phone as *symbolic capital*. These symbolic elements of mobile phone use have also been confirmed in studies of mobile phone use in organizational contexts (Manning, 1996). However, Manning (1996) found that the mobile phone was status-enhancing at some levels in the organization while it was status-reducing at other levels. Consequently, Manning observed what he termed "countersymbolization" and "counterappropriation" used to express an opinion against adopting the mobile phone as well as excessive eager among others to adopt the phone for symbolic reasons.

There is also a relationship between symbolic capital and *social capital* when the object of symbolic value is a communication medium. In that case, there is a relationship between style as a way of communication and style as an indication of group membership (Weilenmann and Larsson, 2000). This gives rise to the idea of text message sending, receiving, filtering and sharing as an expressive communication activity used to display style and social capital. Because text messaging is asynchronous, discrete and stored (at least for a while), this particular use of the mobile is better suited as a style and social identity marker among experienced users than regular calls. These explanations all support the importance of including subjective norms and, consequently, external and interpersonal influence as important adoption determinants of mobile services.

The explanation of mobile service usage as "*ritual gift giving*" applies particularly to the explanation of text messaging services (Taylor and Harper, 2001a, b; Johnsen, 2001). For example, Kaseniemi and Rautiainen (2002) observed three additional uses of text messaging besides regular peer-to-peer messaging; message collection, chain messaging and collective reading. Most other studies of teenage text messaging use have reported similar behaviors (Ling and Yttri, 2002, Larsson, 2000). Taylor and Harper (2001a,b) give references to alternative explanations of gift-giving behavior that fits the observed use of text messaging, such as ritual explanations rooted in primitive elements of our culture, but also sociological, social psychological and economic explanations of gift-giving have been suggested. Based upon this theory, text messaging may be adopted for social influence reasons (pressure to participate in the ritual gift-giving), or it may be explained instrumentally (in which text messaging based gift-giving practices are adopted for utilitarian reasons). In adoption research, the first explanations will be represented by subjective norms while the second will be represented by a reinterpretation of what is considered useful in a service (usefulness).

Ling and Yttri (2002) have suggested that text message adoption among teens may be explained by a theory of *social learning and development* (and emancipation) because text messaging are particularly well suited for exchanging ideas on issues focused in teenagers social learning (e.g. exploration of sexuality, social interaction). For example, many of the chain messages identified by Kaseniemi and Rautiainen (2002) were of sexual content and were used to explore the limits of appropriate content in messages. It is believed that exploring the limits of what is considered appropriate behavior is part of adolescent learning, and thus a widespread adoption is observed for social learning reasons.

Another suggestion is that the asynchronous form of messaging is particularly well suited for initiating and exploring new relationships (Ling and Yttri, 2002, p. 160). For example, Ling and Yttri (2002) mention several situations in which text messaging is preferred to voice because it is used as an awareness or initiating communication service similar to what Nardi et al. (2000) report for instant messaging services. Thus, a *social network explanation* is introduced in which the difference between teenagers and other users is explained by the social networks of teenagers being more dynamic.

In addition to these, mainly social explanations of messaging service adoption and use among young users, there have also been some domestication studies following the line of reasoning from functionally oriented, work/leisure context studies. For example, Grinter and Eldridge (2001) studied the adoption of text messaging among teenagers and found that text messaging were preferred to other media because it was considered quicker, cheaper, easier and more convenient to use. Karlsen et al. (2001) found a remarkable orientation towards usability and costs in their study of the potential adoption of mobile Internet services among Norwegian teenagers. Thus*, instrumental or utilitarian*

explanations of the adoption of these services are relevant also for younger users.

The most recent trend in domestication research on mobile service adoption treats contexts as dynamic and end-users as "negotiating and managing their numerous identities and relationships" in a "role-to-role" society (Green et al., 2001, p. 150; Wellman, 2001). Applying this perspective, Palen et al. (2001) found that the "mobility of ones profession", the "number of roles one assumes professionally and personally" and the "degree of integration one has across those roles" influences mobile service adoption (Palen et al., 2001, p. 116). This issue of role management has been given little attention in previous research on ICT-adoption, but should somehow also be integrated into a comprehensive model of mobile service adoption. Even though most domestication studies of mobile services have focused on societal consequences of use, boundaries of use, and gender and age differences, many of the suggested explanations of adoption versus non-adoption are relevant, and should be integrated into a general adoption model of mobile services.

Research following the principles of domestication research may to some extent also be found on the "stationary" versions of some of the services or technologies investigated in this report. For example, several streams of research can be identifies within traditional gaming research. These lines of research can be categorized into studies on educational effects of gaming (Condry and Keith, 1983; Greenfield and Cocking, 1994), gender issues in gaming (Kaplan and Kaplan, 1981; Vered, 1998; Yates and Littleton, 1999), cultural and race issues (Myers, 1991; Marshall, 1997; Ndalianis, 1997; Hart, 1999), clinical effects of gaming/medial studies (Green, 1982; Brasington, 1990: Hart, 1990) psychological/developmental effects of gaming (Blumberg, 1998; Anderson and Buschman, 2001), and finally, the effects of gaming on

violent behavior (Anderson and Ford, 1987; Anderson and Morrow, 1995; Dill and Dill, 1998; Funk et al, 1999). Whereas these gaming studies primarily focus on *negative* consequences of gaming, such as violence and aggression (e.g. Anderson and Morrow, 1995; Dill and Dill, 1998), reinforcement of gender roles (Cassel and Jenkins, 1999; Dietz, 1998) and social isolation and dependence (Roe and Muijs, 1998; Griffith and Hunt, 1998)[2], some studies of *favorable* effects of video- and computer gaming can also be identified. For instance, Dempsey et al (1996) focus on learning effects, Pillay et al (1999) on recreational effects, and Colwell et al. (1995) on effects on individual self-esteem and self-concepts. However, as can easily be noted from these categorizations, the vast majority of gaming-research focuses on the *effects* of gaming across a large variety of outcome variables – very few studies consider the process of gaming *adoption* and determinants of use.

A few researchers have also been investigating what may be termed "domestication" issues in the use of payment services. For example, Singh (1999, 2000) has studied the perception of money across cultures and demographic groups. She argues that multiple forms of payment will exist because, if seen in the context of the "social meaning of money", different forms of payment have different relative social and cultural advantages rather than technological advantages. She also refers to Zelizer (1994) who suggest that even if payments are standardized into one form of payments, multiple monies exist in social settings. Singh (1999) suggests understanding this complementarity of payment forms is a prerequisite for understanding the adoption and diffusion of electronic forms of money as well. There are also findings along this line of research indicating that electronic forms of payment create new patterns of exclusion. For example, Pahl (1999) shows that

[2] As cited in Knobloch (2001)

electronic forms of payment have changed the "balance of financial power within families" because men make more use of electronic forms of money and are also dominant users of Internet banking. Even though this line of research contributes to a general understanding of the "sociology of money" (Singh, 2000), the number of studies is small and its relevance to the particular issues of mobile payment services adoption is somewhat limited. Still, they indicate that different forms of payments seem to be complementary both because of their relative advantages and because of the perception of multiple monies in social contexts such as family households (Zelizer, 1994).

2.5 General model

While the research presented above indicates that segment differences should be expected in models of mobile service adoption, few findings are directly relevant for proposing service specific model differences. Based upon this review and previous research (Pedersen, 2001, 2002), we suggest applying a common model to all service categories and rather investigate model differences a posteriori. The model represents a modification and extension of the theory of planned behavior (TPB). In figure 2.1, the modified TPB-model is illustrated. We use this illustration as a basis for the discussion of how the general TPB-model is extended and modified.

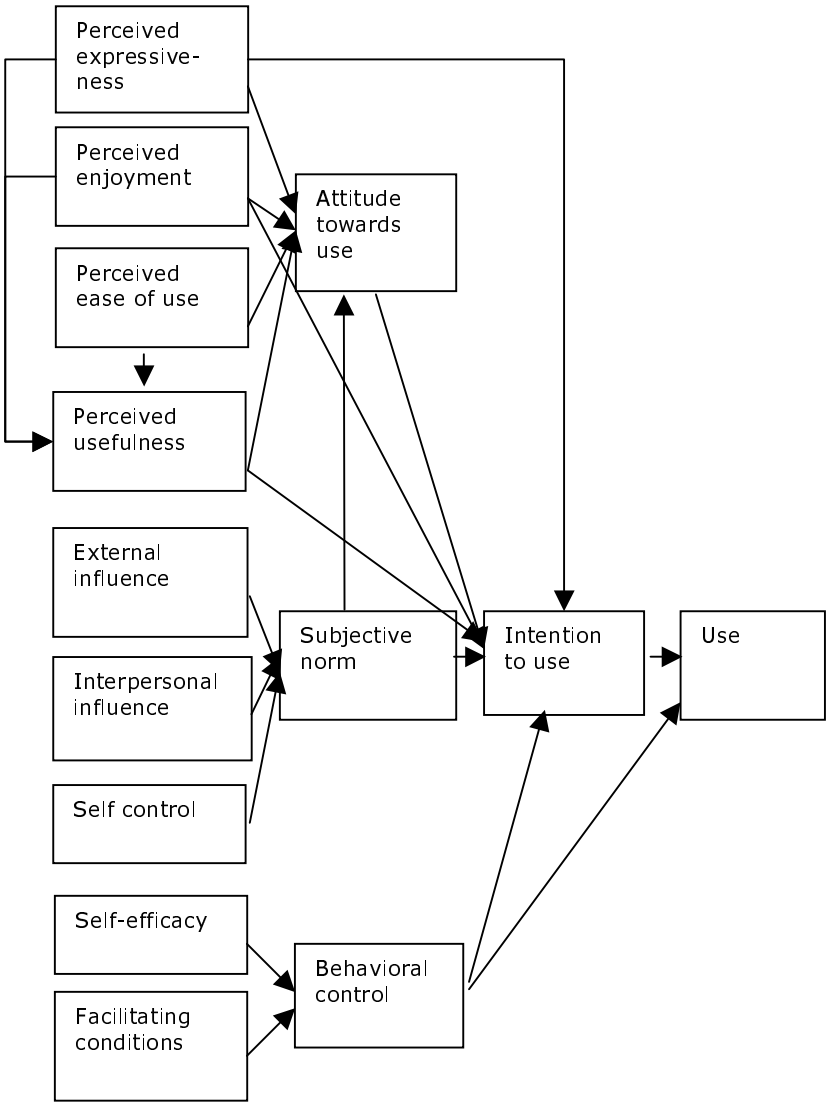

Figure 2.1 Proposed model of mobile service adoption

When applying the TPB-based adoption model of figure 2.1 to study the adoption of mobile services, findings from the research directions reviewed above suggest modifications and extensions, and also provide a basis for proposing adoption model differences across service categories and user segments. Two issues are of relevance with respect to *ease of use* in the model. Because many early adopters of mobile services are young users, the higher competence of younger users and their more exploratory and advanced use of service functionality suggest ease of use should have less influence in adoption models of mobile services. Younger users may be more skilled and experienced

technology users and thus, ease of use may not be as important for these users as for other users. However, studies also report a more playful use of mobile phones among younger users and consequently they are more focused on exploring the functionality of a service. For example, the practice of personalizing the phone or service is typical among young users (Oksman and Rautiainen, 2001). This also indicates that younger users may perceive ease of use differently. For example, if personalization, filtering and adjustment of initial settings are not offered by an application or service, its user friendliness may be perceived as low. Studies have also indicated a relationship between digital capital and symbolic capital suggesting that services designed for young users should not be too easy to use (Taylor and Harper, 2001b) because then, no status would stem from being able to handle the device, application or service. These findings indicate that even though ease of use in general is believed to be of little importance to mobile services (Ling, 2001b), it may be even less important to young users. Opposing these findings is a qualitative domestication study by Grinter and Eldridge (2001) of 10 teenagers' text messaging use. They found that despite their apparent skillfulness, the teenagers often misinterpret and misunderstand the content of text messages. Thus, while the functionality of the service is easily managed, young users indirectly create a level of sophistication in service use that raises new barriers to adoption.

The other issue is that of service differences in the importance of ease of use. For example, studies applying the perspective of "flow" and "telepresence" have shown that to provide intrinsic motivation, some services must represent a certain challenge to the user. Challenge positively influences flow through increased telepresence (Novak et al, 2000; Hunter and Kalafatis, 2001). This, in turn, implies that we might expect a negative effect of ease of use (challenge inversed) on perceived enjoyment for highly involved users and for services

which are used for reasons of intrinsic motives. One example is mobile gaming services.

Perceived *usefulness* was originally seen as a fairly simple concept including components such as effectiveness and efficiency that are mainly related to extrinsic motivation in work contexts. Later, researchers have included elements of intrinsic motivation in the definition of both ease of use and usefulness (e.g. Thompson, Lim and Lai, 1999). However, intrinsic motivation has mainly been associated with ease of use and extrinsic motivations with usefulness. As seen from uses and gratifications studies, the extrinsic motivations of mobile services are not limited to effectiveness and efficiency. Motivations of accessibility, flexibility, sociability and security have all been mentioned in these studies. These motivations are not limited to mobile services, but are typical of communication (as opposed to information) services. In addition, motivations of enjoyment, fashion, and status and expressiveness have all been mentioned. Some of these motivations are intrinsic, but other may perhaps best be characterized as derived, meaning that they provide an instrumentality or gratification that was not intended by design and that perhaps also was not considered by the user at the time of the adoption (Pedersen, 2002). For example, intrinsic motivations of enjoyment lead to skills which provide the user with digital capital, which in some social networks gives access to both symbolic and social capital. Thus, the traditional usefulness concept should be modified and extended when trying to explain the adoption of mobile services.

First, traditional usefulness, such as efficiency and effectiveness may be less important in services designed for everyday life use. Thus, one is lead to the hypothesis that traditional extrinsic motivations are less important. However, extrinsic motivations derived from uses and gratifications research should be

included in the usefulness concept. Thus, effectiveness and efficiency should be related to availability, flexibility and security, but these concepts may be interpreted as determinants of usefulness of a service or as components of usefulness. We find that by redefining and modifying the usefulness concept, these conceptions of usefulness may be included as components of usefulness. Thus, we find no need to replace the usefulness concept with more specific instrumental components to cover the differences in extrinsic motivations of mobile and traditional services. However, studies also suggest that the usefulness concept should be extended and supplemented to cover the issues of intrinsic and derived motivations discussed above. For example, *enjoyment and entertainment* go beyond ease of use and usefulness, and are perceived as instrumental of services primarily designed for entertainment (mobile games, mobile video and audio streaming, chat and flirt services) (Leung and Wei, 1998, 2000). The instrumentality of these services is enjoyment and entertainment in itself, not the efficiency or effectiveness of being able to access mobile entertainment services ubiquitously. This indicates that enjoyment should be included in adoption models developed for users of mobile services as a separate concept contributing both to perceptions of usefulness, ease of use and attitudes towards use.

To get access to symbolic and social capital by using a service, a requirement is that it has some element of *expressiveness*. It should be possible to express style (in all Ling's (2001b) conceptions of style) using the service. In addition, many mobile services are communication services primarily, and thus, the extrinsic motivations for using the service are communication-related. In addition, the requirements of expressiveness suggested by domestication research also include using the communication service to communicate at several levels, to demonstrate participation in several networks maintaining different roles, and to share and collect prior communication sessions. These

are all expressive elements of communication that originate in the derived motivations discussed above. In CMC-research, expressiveness is compared to instrumentality as two styles of communication (Boneva, et al. 2001). Expressiveness is used of communication in relationships of emotional intimacy and sharing, while instrumentality is used of communication in relationships based on common activities. For example, Boneva et al. (2001) believes female communication to be more expressive, while male communication is believed to be more instrumental. Based on these assumptions, services that communicate expressiveness in this form are more likely to be appreciated by female users. Expressiveness is an instrumental attribute of a communication service partly influencing usefulness and partly influencing attitudes directly. Thus, we should expect that expressiveness is more relevant when explaining the adoption of communication services than information services. The term expressiveness has also been used in other traditions, such as personality research and consumer psychology. We discuss some of the conceptions of expressiveness in these traditions in section 3.

Attitudes are generally believed to be the results of personal and social influences. However, in the technology acceptance model (TAM), attitudes towards use are determined by personal influences only. When including subjective norm in the model, it is possible to create a relationship between norms and attitudes that may be particularly relevant to young users' adoption of mobile services. However, it is also important to conceptually discriminate norms and attitudes in adoption models. Thus, we suggest accepting an influence of subjective norm on attitudes, but reject including influences of external and interpersonal influence on attitudes directly. We also suggest extending the determinants of attitudes towards use from purely instrumental determinants to more derived determinants such as enjoyment and expressiveness. However, the attitude formation process is believed to be

similar for usefulness, ease of use, enjoyment and expressiveness in that the individual sees a service as instrumental in fulfilling intrinsic, extrinsic and derived gratifications, and consequently develops a positive attitude towards using it. The relationship between attitudes and intentions may be different for different service categories. For example, for services that are widespread and well known, it is easy to obtain information on other users' experience and also to gain experience from actually using the service oneself. This indicates that for established services, instrumental and experiential motives are the most important explanations of user intentions. On the other hand, if services are new and unknown, intentions to use services may be based upon general attitudes and less on experientially derived motives.

Above, we have discussed one of the two aspects of *external influence*; the symbolic capital derived from style in all its conceptions. The other aspect is that of external influence on the development of subjective norms. The first aspect of external influence is how a user of mobile services uses these services to more or less consciously express style and get access to symbolic capital. The second aspect is how external influence represents an external pressure on the user to develop a specific norm and consequently, show a specific behavior. The two aspects have also been characterized as the "reciprocal influences" of mobile phones by Alexander (2000). External influence also represents an important determinant of expectations, and may influence perceptions of instrumentality as well. However, as technology gets domesticated, expectations are replaced by the generalization of experiences, and for explaining the adoption and use of text messaging services, expectations are believed to be less important. For less domesticated services, however, expectations are more important, but in the adoption process, these expectations are also reflected in attitudes. Thus, the difference in the influence of attitudes on intention to use a service may be explained by expectations, but it is difficult

to trace this particular influence in an adoption model. The second aspect of external influence, the determination of subjective norm, is believed to be particularly important to young users (Leung and Wei, 1999; Ling, 2001b). Young users may be more affected by external influence because their subjective norms are developing and changing, they may be more exposed to the sources of external influence, such as general mass media, and they are more directly approached by persuasive advertising by terminal vendors and operators (Townsend, 2000). Thus, for services particularly focused at young users, we may find external influence more important than for other services. External influence may also differ by service category. Some services are mainly communicated using word-of-mouth mechanisms while the introduction of other services is accompanied by large advertising budgets of providers and operators.

Interpersonal influence has been suggested as important in explaining the adoption of communication technologies in CMC-studies and the adoption of mobile and messaging services in domestication research. However, there are issues of instrumentality that must be separated from issues of social influence in communication services. We have discussed issues of instrumentality related to the management of and access to social networks, and related to symbolic capital above. Interpersonal influence is the influence of others in developing norms that the use of a particular service is expected. In principle, it is unrelated to instrumentality. Almost all explanations in domestication research introduced above include elements of interpersonal influence. For example, the suggestion that young users are more subject to social influence because they are at a stage of social development and learning (Ling and Yttri, 2002), the suggestion that young users' social networks are more dynamic and thus exposed to influence than other users' (Oksman and Raitiainen, 2001), or the interaction between symbolic and social capital that makes instrumental

motivations and social influence interrelated for communication services. Consequently, interpersonal influence is assumed to be more important when explaining the adoption of communication services and the adoption of services that is particularly directed at young users.

Studies in domestication research have also focused on the importance of individuality and the relationship between individuality and social pressure as both a determinant and consequence of mobile service use (Fortunati, 1998; Skog, 2002). Thus, determinants of individuality and resistance to social pressure should be included as components or moderators of subjective norm. We suggest including the concept of *self-control* as an extension of the self-efficacy concept of TPB and as an additional determinant of subjective norm. While self-efficacy (related to adoption) is an individual's self-confidence in that adoption will lead to the desired behavior (Bandura, 1982), self-control is often believed to include self-efficacy, but also go beyond it (Rosenbaum, 1980). For example, self-control is related to time dependence when an individual chooses not to consume something today because the utility is believed to be higher from consuming the good at a later point in time. In a study of mobile commerce service adoption (Pedersen, in press), self-control was identified as a very important determinant of subjective norm, improving the explained variance in subjective norm from 38 to 45%. In addition, elements of self-control and individuality are included in many qualitative studies as particularly important when understanding mobile service use among young users. For example, Oksman and Rautiainen (2001) have shown how the mobile is used by parents as an instrument in the emancipation process of adolescent users. Simultaneously, it is used as a symbol of increasing individuality and self-control by young users. Thus, self-control is believed to be an important component or moderator of subjective norm, and its influence is likely to vary with the age of the user. In addition, self-control is most

important as a moderator of subjective norm for services where interpersonal influence is believed to be the most important determinant. This is mainly because self-control is a concept involving self-consciousness particularly with respect to the influence from other people, and not so much with respect to media influence.

Subjective norms are the norms developed through external and interpersonal influence. In general, Webster and Trevino (1995) suggest social influences, and thus, subjective norms to be more influential in explaining the adoption and use of new media. The question, however, is which services should be considered new media in the Norwegian market for mobile services. In an international setting, most mobile services may be considered new media, but in Scandinavia, text messaging is now well integrated in the everyday lives at least of young users. Consequently, even though social motivations for adoption may be important, these motivations may by now be more instrumental than norm based, and should be identified through instrumental determinants of attitude toward use rather than through subjective norm. To give an example, young users may find text messaging instrumental in social coordination because all other members of their social network use it, but still feel little social pressure towards using text messaging services as a norm. However, some mobile services are still at an early stage of development and may be considered new media. Thus, subjective norm is generally believed to be more important to less widespread services. On the other hand, our arguments for a difference in the influence of external and interpersonal sources of influence between communication and information services suggest subjective norm may be more important to communication services than to information services regardless of the degree of service novelty.

As indicated above, *self-efficacy* in this context is the individual's confidence in that adoption of a service will lead to the desired behavior (Bandura, 1982). The determinants of self-efficacy are typically found in attributes of the individual adopter, such as experience, skills and education. Young users are generally believed to be among the more experienced and skillful users of these services (Ling, 2001c; Skog, 2002). For example, Oksman and Rautiainen (2001) found that adolescents found mobile phones to be a more controllable technology than PC's. Thus, one may expect that self-efficacy in general will be higher among young users than among other users in general, and thus, of less importance as a determinant of adoption. Self-efficacy will also be of more relevance to services that require skilled or experienced users. Accordingly, the influence of self-efficacy on behavioral control will be greater for services with some degree of complexity, services that require integration with a service infrastructure outside the providers' network, and services that includes challenge as an integrated part of its gratification. For example, behavioral control will be more influenced by self-efficacy for payment and gaming services.

A variety of *conditions may facilitate* or inhibit the use of mobile services. In general, lack of facilitation is believed to reduce the perceived behavioral control of a service or technology. Examples of such conditions are price, service and terminal availability, support, roaming and interconnect, security issues and service compatibility. In general, these conditions are controlled by the facilitators (operators, service providers) and individual users (through their resources). Recent developments of services particularly for the young segment, and the widespread use of prepaid service plans particularly designed for young users suggest that the facilitating conditions controlled by the providers are perceived as good in young user segments. In addition, the social networks of young users function as support networks trough the interaction

mechanisms of digital, symbolic and social capital discussed above. On the other hand, young users in general have limited financial resources. However, prior studies (Grinter and Eldridge, 2001) have shown that when compared to voice services, text-messaging services were believed to be cost-efficient services. Still, other studies (e.g. Karlsen et al., 2001) have shown a cost consciousness among young users that obviously makes facilitating conditions of importance to young users. In general, Carroll et al. (2002) mentioned the issue of hidden costs that appear after users' appropriation as a particularly important determinant of what they call disappropriation - that the users stop using a service after an initial adoption. Thus, behavioral control will be more influenced by facilitating conditions for services of greater complexity and for services requiring infrastructure integration. Also for services requiring new or specific terminal types, expensive services, and services with hidden costs, the influence of facilitating conditions on behavioral control will be greater.

The inclusion of *behavioral control* in TPB has been an important contributor to its explanatory power. In general, we have argued that the determinants of behavioral control are believed to be less important to young users than other users because of their experience and skill in using mobile services and the providers' facilitation of mobile services such as text messaging services to the young user segment. Financial resources and pricing, however, are indirectly believed to be important determinants of behavioral control due to both limited resources among young users and recent findings that these users are more price sensitive than previously assumed (Karlsen et al., 2001). However, the perception of some mobile services (e.g. text messaging) as cost efficient services makes users perceptions of behavioral control of these services less important as a determinant of adoption than of voice services or complex services with hidden costs (e.g. GPRS-based services). Behavioral control is a general term composed of elements of individual traits and perceptions of

operators' and providers' facilitation. It is also likely that the influence of behavioral control will vary across mobile services. In general, we have argued that the influence of self-efficacy on behavioral control is greatest for complex, new, integrated, expensive and terminal demanding services. The same may thus be argued of the influence of behavioral control on intention to use services. For example, the adoption of technically complex services, services requiring advanced terminals, services with hidden costs, and generally expensive services will be more influenced by behavioral control than simple and cost efficient services. Thus it is likely to expect a greater influence of behavioral control on intentions to use for gaming and payment services than for text messaging and contact services.

Implicit in our presentation of the model and its concepts and relationships, we have suggested several hypotheses. In this report, however, no hypotheses have been explicitly formulated. The main propositions we make are: First, that adoption models provide a valuable basis for going from the description of the adoption of mobile services towards explaining it. Second, that traditional adoption models need modifications and extensions when being applied to the adoption of mobile services. Based upon the prior discussion, we also propose that there will be differences in the adoption models of different service categories. Some of these differences and their theoretical foundation are summarized in table 2.1. The lack of prior confirmatory studies in the area of mobile service adoption makes us prefer a more exploratory approach, and only propositions, not formal hypotheses, are suggested in table 2.1.

Table 2.1 Service specific propositions of differences across adoption models

Concept	Service specific propositions
Ease of use	Ease of use is generally more important to complex services and services requiring an underlying infrastructure (payment services) Challenge and ease of use may be portrayed as opposing concepts, and ease of use will thus play a lesser role in explaining the adoption of gaming services than of the remaining services.
Usefulness	Usefulness is related to the instrumental gratifications of the services - for contact and gaming services these are intrinsic, while they are mainly extrinsic for texting and payment. The conception of usefulness itself is service- and context- dependent indicating that usefulness should be considered a relative concept.
Expressiveness	Expressiveness is more important as a derived gratification of communication services (texting and contact services) than of information services.
Enjoyment	Enjoyment is a stronger intrinsic motivator for the adoption of Contact- and gaming services than for communication services.
Attitude	Attitudinal influence is more important than experiential influence in explaining intentions to use *new* services (i.e. more novel services than texting, and to some extent contact services).
External influence	External influence is more important in determining norms for information services (as compared to communication services), particularly those initiated by the providers or operators (payment and to some extent gaming).
Interpersonal influence	Interpersonal influence is most important in determining norms for using communication services (texting and contact).
Self-control	Self-control is a more important moderator of subjective norm for services where interpersonal influence is important (communication services).
Subjective norm	Social influence is generally believed to be most important to services with social network gratifications (primarily communication services - texting and contact). For similarly gratified services, subjective norm is more influential in determining intention to use a novel service than a domesticated service (contact versus texting services).
Self-efficacy	Self-efficacy is a more important determinant of behavioral control for complex services, services requiring an underlying infrastructure and challenging services (payment and gaming)
Facilitating conditions	Facilitating conditions are more important for complex services, services requiring integration with an underlying infrastructure, advanced or new terminal types, and services that are perceived as expensive or having hidden costs (e.g. requiring bandwidth) (payment, gaming)
Behavioral control	Behavioral control will be more influential for complex, integrated, new, terminal demanding and expensive services and for services involving perceptions of hidden costs (e.g. payment and gaming services)

In addition to specific propositions of adoption model differences across service categories, the discussion above also indicates that we should expect adoption models to differ across user segments. In particular, issues of gender and age differences have been mentioned. However, these differences are not likely to be independent of service category, but rather result from an interaction of user segment characteristics and service category characteristics. Thus, we propose that there will be adoption model differences across segments, but that these differences will interact with service characteristics.

The general proposition that the adoption of mobile services may be explained by a modified and re-specified version of the theory of planned behavior, and the specific propositions on how adoption models will differ across service categories and segments were investigated applying four individual studies of mobile service adoption. The method and results from these studies are reported in sections 3 and 4.

3. METHOD

Four individual studies were conducted to investigate cross service differences in the adoption model of section 2. For text messaging services, a traditional paper based survey was administered at three upper secondary schools in Agder. For contact services, subjects were recruited to participate in a web-based version of the survey from the SMS-services pages of the newspapers of A-Pressen. For mobile payment services, subjects were recruited to a web and paper-based version of the survey from a saldo-tail[3] of "RingKontant" customers. For gaming services, subjects were recruited to a web-based survey from gaming and mobile gaming discussion forums on the Internet. Thus, a comprehensive set of studies has been conducted to provide cross service data on mobile service adoption. We present the design, sample and measures used in these surveys here.

3.1 Design, procedure and sample characteristics

All surveys were designed as simple one-group posttest designs. A quasiexperimental setting was applied by first presenting a set of services to the subjects asking them to indicate their use and intended use. Next, subjects were given a stimulus text focusing on one of the listed services or service categories. For example, in the contact services survey the following stimulus text was used: "*We now want you to focus on mobile services that in different ways are used to get in contact with new people. We term these services mobile contact services. Examples of mobile contact services are regular chat-services and flirt-services on the mobile (e.g. SMSFlørt) and chat services using text messaging to Teletext services or to a TV-program (e.g. SmsPrat and Sone2)*

[3] By "saldo-tail" we mean the text that is presented in an account balance information service for mobile service users.

Sending regular text messages directly to other people is not relevant here." This type of statements represents the stimuli used to introduce the service context to subjects. Thus, the interpretation of all measures in each study should be made within this context.

The text messaging survey was administered by school contacts at three upper secondary schools in the Agder region during a period of three weeks in March, 2002. The questionnaire was answered during dedicated class hours giving a response rate of 62.3% (N=658) (of the number of questionnaires distributed) after careless respondents had been removed. The contact services survey was announced at 40 online newspaper sites controlled by "A-Pressen Interaktiv" using an ad that was presented at times and on pages when the newspapers had "unsold ad space" in the period from July 1 to August 1, 2002. Most presentations were given at the SMS-services pages of the newspapers. The survey was entirely web-based and when compared to the number of subjects clicking on the ad, the response rate was 43.6% (N=684). Careless respondents using less than 180 seconds on the survey was removed.

The payment services study was conducted by including a recruitment text in the SMS account balance service of the prepaid customers of Telenor. The text suggested either visiting the study web-site or replying "contact" by SMS to be contacted by project researchers. When being contacted, project researchers asked for respondents' addresses to mail them the survey questionnaire. The contact based version of the recruitment method was used for one day, while the web-based method was used for 2 days in April, 2002. A total of 579 respondents visited the survey web site and 320 (55.3%) completed this version. 313 questionnaires were mailed and 175 (55.9%) returned a completed mail version of the survey. Careless respondents using less than 180 seconds to complete the web-based version were removed. The gaming services study was

announces using regular posts at 28 international and national web-based discussion forums for gaming, mobile gaming and mobile entertainment services. All postings were made to announcement and news topics at the forums not to provoke forum discussants and to obtain interested respondents. In addition, requests were sent to webmasters at four mobile gaming application sites asking them to include a link to the survey on their site. The link was finally implemented at "Midletcentral.com" only. The posts and link resulted in 1030 visits to the survey web sites. 201 (19.5%) respondents completed the survey after careless respondents had been removed. Sample demographics of all four studies are shown in table 3.1.

Table 3.1 Sample demographics

Age	Texting	Contact	Payment	Gaming
0-19	97.3	9.9	29.1	19.2
20-29	2.6	40.2	42.8	50.3
30-39	0.0	28.0	17.7	24.4
40-49	0.0	14.0	7.2	5.2
50-59	0.0	6.7	2.7	1.0
60 and above	0.0	1.1	0.6	0.0
Education				
Primary	n/a	8.3	38.4	2.6
Secondary	n/a	43.1	52.5	17.0
University <3	n/a	28.2	7.9	32.0
University >=4	n/a	20.3	1.2	48.5
Sex				
Male	44.3	55.2	44.9	91.1
Female	55.7	44.8	55.1	8.9
N-complete	658	684	495	201

From table 3.1, we see that there are big differences in sample demographics. The text messaging study was conducted among upper secondary school students, and demographics are as expected. The contacts services study shows a distribution of subjects with an age, education and gender distribution corresponding to the general Internet population. The sample of the payment

service study represents the population of prepaid customers. Consequently, the corresponding proportion of female subjects is larger, and the sample consists mainly of younger users without university education. Finally, the sample of the gaming services study represents the population of international mobile gaming discussants with a large proportion of male subjects and a large proportion of university educated users. Even though the samples are representative of their core populations, further analyses of our data should be controlled for the identified age, gender and education differences before cross population generalization is recommended. In particular, the age and gender differences have been carefully controlled throughout this study.

3.2 Measures

The model presented in section 2 includes 14 concepts: Ease of use, usefulness, expressiveness, enjoyment, attitudes towards use, external influence, interpersonal influence, subjective norm, self-control, self-efficacy, facilitating conditions, behavioral control, intention to use and actual use. Most of these concepts are well founded in adoption, uses and gratification, or domestication research literature. Consequently, the construct validity of these concepts is in general considered acceptable. To measure the concepts, a questionnaire was designed containing multiple measures of each of the 14 concepts. In general, the concepts were measured by the subjects indicating their agreement with a set of statements using a seven-point scale ranging from "strongly disagree" to "strongly agree". Some concepts were measured using seven-point scales of bipolar adjectives. For each measure, the items were adapted to the service studied. This means the wording of the items was referring to different contexts as well as to different purposes of use for each service. Still, the wording was kept as similar as possible across studies. A sample questionnaire used for payment services is found in appendix A. In table 3.2, the reliabilities of each

of the measures for each of the studies as well as the reliabilities of the measures when joined across studies are shown.

Table 3.2 Measure reliabilities

Measure / Study	Texting	Contact	Payment	Gaming	Total
Ease of use	0.88	0.96	0.93	0.90	0.95
Usefulness	0.86	0.91	0.86	0.77	0.89
Expressiveness	0.75	0.92	0.85	0.87	0.85
Enjoyment	0.93	0.96	0.94	0.94	0.96
Attitude	0.85	0.94	0.89	0.90	0.93
External influence	0.63	0.82	0.79	0.81	0.75
Interpersonal influence	0.72	0.92	0.88	0.88	0.85
Subjective norm	0.80	0.90	0.83	0.94	0.85
Self-control	0.80	0.88	0.90	0.84	0.87
Self-efficacy	0.80	0.80	0.85	0.74	0.84
Facilitating conditions	0.74	0.79	0.87	0.77	0.81
Behavioral control	0.66	0.80	0.75	0.82	0.78
Intention to use	0.80	0.91	0.87	0.92	0.91
Use	0.91	0.91	0.88	0.90	0.92

From table 3.2 we see that the reliabilities of external influence and behavioral control in the text messaging study were below the acceptable 0.75 limit set by Nunnally (1978). Based on these results, the measures were refined between the text messaging study and the other studies by removing unnecessary items. This also improved the reliability of the two low reliability items, and provided an overall reliability of all items that was considered acceptable.

Ease of use was measured using four items developed from adapting the original items of Davis et al. (1989) to our setting. Similar operations are found also in Taylor and Todd (1995) and in Battacherjee (2000). Usefulness was measured using four items covering the original dimensions of time saving, improvement, usefulness and quality suggested by Davis (1989). Because the settings of our services are mainly everyday life situations, the original items of

Davis had to be converted into more "everyday life" terms and adapted to the individual service contexts. Attitude towards use was measured using four bipolar adjectives indicating different aspects of the subjects' attitude towards use. The items were very similar to those used by Davis (1989), Taylor and Todd (1995) and Battacherjee (2000). The enjoyment concept was defined as incorporating a group of gratifications identified in studies of the Internet as "enjoyment" (Pappacharissi and Rubin, 2000), of ICQ as "entertainment" (Leung, 2001), of mobile phones as "relaxation" (Leung and Wei, 2000), of pagers as "fun-seeking" (Leung and Wei, 1999b), and of text messaging as "nutz-spaz" (Höfflich and Rössler, 2001). To cover these elements of enjoyment, a four item scale was developed collecting items from uses and gratification scales. The first of the item covered the "entertainment" conception, the second the "relaxation" conception, the third item covered the "excitement" conception also found in studies of video-game and TV-gratifications (Sherry et al., 2001). The final item was a general item covering the "fun-seeking" gratification. The wording of each item was taken from uses and gratifications studies reviewed above.

The choice of a particular concept - "expressiveness" - as a perceived attribute of a service or technology is unique in our model. The term has been used in social psychology of individuals' general ability to express their emotions or identity. For example, in family relationship studies it is used as a measure of how well emotions are expressed by parents and children and how this influences family relationships (Cassidy et al., 1992). In research on identity formation and personality, it is used as a measure of the relationship between what a person believes about herself (what her potentialities are, see Schwartz et al., 2000, p. 507), and how she expresses herself, using the concept of "personality expressiveness" (Waterman, 1993). In this line of research, a person expresses herself through activities, and expressiveness is measured by

subjects indicating how important these activities are in expressing their identity. In consumer research, the expressiveness concept has been extended from individuals to products indicating how well a product expresses values beyond instrumental utility (Mittal, 1994). Thus, value-expressive products are seen as expressing the consumer's identity. While the expressiveness concept in consumer research covers gratifications of prestige, fashion, pride and mood stimulation, it primarily focuses issues of how products are used to "express my personality" and are "compatible with how I like to think of myself" (Mittal, 1994, p. 258). Thus, items measuring these conceptions of expressiveness have been included. In addition, expressive gratifications have been identified in uses and gratifications research. For example, Arnett (1995) included "identity formation" as a particular gratification of young users, Leung (2001) included "express affection", "fashion" and "inclusion" as gratifications of ICQ-use, and Leung and Wei (1999b, 2000) included "fashion and status" as a gratification of both pager and mobile phone use. From these studies, a status-related expressiveness item was suggested Studies of text messaging use have shown how one of the most important ways of expressing ones service use is to discuss the service with others and to share it with others (Larsson, 2000; Grinter and Eldridge, 2001; Kaseniemi and Rautiainen, 2002). Thus, items referring to this particular form of expressiveness were included. Similar items, measuring the gratification of sharing technology use with others - social interaction, have been included in studies of video games as well (Sherry et al., 2001) and TV (Lee and Lee, 1995).

The measure of external influence was based on two sources of influence - media and society or profession. Thus, it includes the measures used by Battacherjee (2000) and Taylor and Todd (1995). The measure of interpersonal influence was based on Battacherjee's (2000) extension of the measures used by Taylor and Todd (1995), and adapted to our setting. Self-control is believed to

be a component of or moderator of subjective norm. Self-control was measured by items reflecting indirect indicators of self-control, such as resisting group pressure, superior influence and group conformity. The items were mainly based upon a subsection of the self-control measure suggested by Rosenbaum (1980). The measure does not capture the whole range of the self-control components as defined by Rosenbaum (1980), but includes some items from these more complex self-control scales. Subjective norm was measured using three items almost identical to the items used by Mathieson (1991) and Battacherjee (2000). A somewhat simpler version of the measure was used by Venkatesh and Davis (2000). In addition, a general norm item was included, inspired by sociological research on mobile service use (Skog, 2002).

The measure of self-efficacy was based on the items used by Battacherjee (2000) and Taylor and Todd (1995), but adapted to our contexts. The measure also corresponded well to the extended *user* resources part of the "resources" scale of Mathieson et al. (2001). The measure of facilitating conditions was based on the same sources as the self-efficacy measure. It included specific items related to the infrastructure of mobile services and the facilitation of service usage by the user's provider or operator. The measure of behavioral control was almost identical to the measure applied by Battacherjee (2000) and Taylor and Todd (1995).

Finally, intention to use and actual use was measured by presenting a list of mobile services organized by user context and complexity to the subjects. The subjects were asked to indicate how much they had used and intended to use these services on a 7-point scale ranging form "very little or not at all" to "very much". Use and intention to use were aggregated over the items presented on the list. To comply more fully with the traditional measures of adoption research, intention to use was also measured with a two item scale adapted from

Battacherjee (2000) and Mathieson (1991). Actual use was also measured using a psychometric measure consisting of three items.

All our traditional measures are based upon previously validated measures (Venkatesh and Morris, 2000), and their reliabilities were considered acceptable. To test the discriminant and convergence validity of the independent variables in our model, the items of all nine independent variables were included in a confirmatory factor analysis including 9 factors. The analysis showed that the nine factors explained 81.8% of the variance in the material. The resulting factor loadings are shown in table 3.3.

Table 3.3 Principal components analysis independent variable measures (loadings below 0.30 are not shown)

Loadings/ Variables	1	2	3	4	5	6	7	8	9
Ease of use 1		.820							
Ease of use 2		.856							
Ease of use 3		.676							
Ease of use 4		.856							
Usefulness 1			.714						
Usefulness 2			.801						
Usefulness 3			.812						
Usefulness 4			.741						
Expressiveness 1					.720				
Expressiveness 2					.729				
Expressiveness 3					.699				
Expressiveness 4					.471	.367			
Enjoyment 1	.807								
Enjoyment 2	.831								
Enjoyment 3	.849								
Enjoyment 4	.865								
External influence 1									.795
External influence 2									.837
Interpersonal influence 1						.722			
Interpersonal influence 2						.746			
Interpersonal influence 3						.699			
Self-control 1								.872	
Self-control 2								.910	
Self-efficacy 1				.722					
Self-efficacy 2				.872					
Self-efficacy 3				.793					
Facilitating conditions 1							.672		
Facilitating conditions 2							.727		
Facilitating conditions 3							.698		

From table 3.3 we find that convergence validity in general is very good. A question may be raised of the discriminant validity of the expressiveness variable. When investigating the particular item further, it was obvious that the wording of this item varied considerably with service context. By removing the

item, however, reliability would suffer. Thus, we decided to retain the measure with four items as presented above.

4. RESULTS

In this section, we present the results of the cross service study. The section is organized in five sub-sections. First, we present individual results from the four studies of each mobile service. Next, we investigate differences in users' service perceptions and compare the adoption models across services

4.1 Text messaging

All studies were initiated with subjects indicating their current use and intended use of a set of mobile services for the next six months. In table 4.1, the results are shown for the services listed to the text messaging service users.

Table 4.1 Actual use and intention to use mobile services

Variable (N>653)	Actual use	Intention
Send ordinary message to friends or family	4.94 (-)	4.77 (**)
Send animated message to friends or family	2.19 (+)	2.23 (*)
Send message to a group of friends or family	1.92	1.95
Send message to unknown	1.41 (-)	1.34 (**)
Sharing message with others on the phone	3.13 (-)	3.00 (**)
Sharing message with others on the Internet	1.12	1.15
Multimedia messaging	2.18	2.21
Answering service for voice	1.92 (+)	1.98 (*)
Voice phone meeting service	1.19 (+)	1.27 (**)
Mobile access to calendar or board sharing	1.08 (+)	1.17 (**)
Find out who has a number	3.13	3.13
Find out where someone are	1.38 (+)	1.64 (**)
Mobile service for contact personals	1.06	1.07
Mobile service for chatting with friends	1.45 (+)	1.50 (*)
Mobile service for chatting with unknown	1.10	1.12
Mobile flirt service	1.18	1.22
Location based mobile flirt service	1.11 (+)	1.18 (**)
Send messages for display during TV-program	1.55 (-)	1.50 (*)
Mobile discussion forum access	1.08 (+)	1.12 (**)
Mobile service for checking email	1.26 (+)	1.59 (**)
Mobile service for sending email	1.22 (+)	1.52 (**)
Mobile service for sending group email	1.15 (+)	1.30 (**)

(*) and (**) indicates significance of difference at $p<0.05$ and $p<0.01$, respectively

From table 4.2 we see that actual use and intention to use are fairly similar for each service. The services most in "demand" are ordinary text messaging, message sharing, phone number services, animated messages, and the new MMS-services. However, it is not clear if respondents have understood the content of the MMS-service because at the time of the survey, this service was not generally available. Even though there are no large differences between actual use and intentions to use, many of the differences are significant. Worth noticing is the anticipated reduction in intended use of ordinary text messaging. The observed difference in use and intentions represents a 3.5% reduction in

service use if actually fulfilled. Worth noticing is also the increase in intention to use location based services and mobile access to email services.

Using the data from the text messaging study, the adoption model of section 2 was estimated. The results of this estimation are shown in the adoption model for the text messaging service illustrated in figure 4.1.

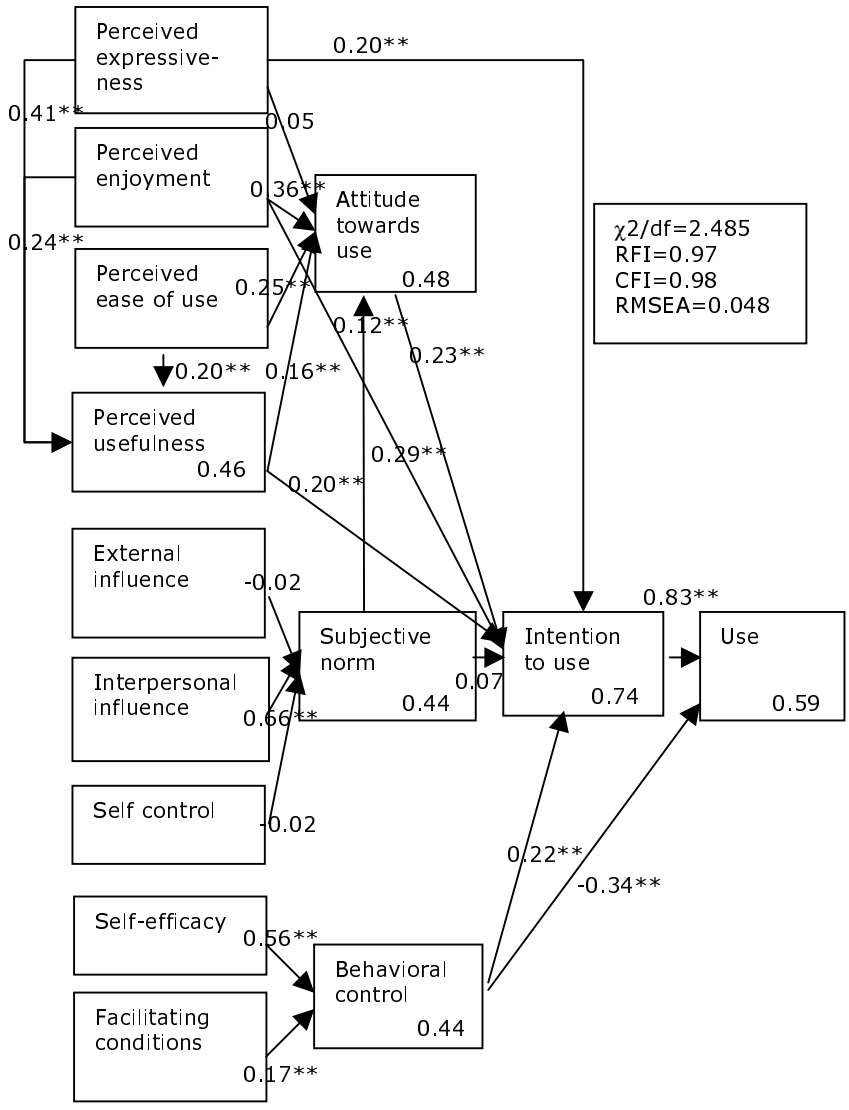

Figure 4.1 Adoption model of text messaging

From figure 4.1, we see that model fit is very good when evaluated by all fit indexes[4]. The model explains 74% of the variance in intention to use text messaging and 59% in actual use. When compared to other studies in adoption research, these results are promising.

When investigating model relationships, we first see that intention to use text messaging is explained by direct instrumentality of usefulness, enjoyment and expressiveness, attitudes towards use and behavioral control. Subjective norm does not significantly influence intention to use text messaging. Usefulness is significantly influenced by ease of use, enjoyment and expressiveness, while attitude towards use is significantly influenced by ease of use, usefulness, enjoyment and subjective norm. Expressiveness does not significantly influence attitudes. Subjective norm is influenced by interpersonal influence only. Behavioral control is influenced by self-efficacy and facilitating conditions. We also observe that there is a positive relationship between behavioral control and intention to use, but a negative relationship between behavioral control and actual use. This relationship has been further investigated in Pedersen (2002) concluding that users of text messaging services seem to perceive some form of deficient self-regulation in the use of these services. From these findings, we conclude that the extended model explains a large proportion of the variance in intention to use, that the suggested concepts of enjoyment and expressiveness are important contributors to this explanatory power, and that subjective norm and its determinants seem less important in explaining the adoption of text messaging services among young users.

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[4] We generally employ parsimony adjusted measures of fit only. According to Browne and Cudeck, cited in Arbuckle and Wothke (1999), a RMSEA less then 0.08 is acceptable. According to Bentler, cited in Battacherjee (2000), $\chi 2/df$ should be less than 5, preferably less than 2, and all other indexes should be close to 1 (Taylor and Todd, 1995). In general, we apply the rules of $\chi 2/df \approx 2$ or better, RMSEA<0.08 and all other indexes ≈ 1.

4.2 Contact services

Users showing an interest in contact services were exposed to a list of mobile services that was somewhat different from the list of the text messaging users. In table 4.2, the actual use and intention to use these services are shown.

Table 4.2 Actual use and intention to use mobile services

Variable (N>740)	Actual use	Intention
Send ordinary message to friends or family	5.02	4.98
Send animated message to friends or family	2.43	2.46
Send message to unknown	1.30	1.31
Sharing message with others on the phone	3.11(-)	3.01(**)
Find out where someone are	1.63(+)	1.97(**)
Find out who has a number	3.35(+)	3.42(*)
Answering service for voice	3.10(+)	3.20(**)
Voice phone meeting service	1.39(+)	1.54(**)
Voice based chat line	1.12	1.12
Mobile access to calendar or board sharing	1.22(+)	1.48(**)
Mobile service for checking email	1.58(+)	2.24(**)
Mobile service for sending email	1.48(+)	2.13(**)
Mobile service for contact personals	1.09(+)	1.12(*)
Mobile service for chatting with friends	1.58(+)	1.69(**)
Mobile service for chatting with unknown	1.15(+)	1.19(*)
Mobile service for flirt	1.19(+)	1.24(**)
Mobile service for location based flirt	1.12(+)	1.18(**)
Sending text messages to a service during a TV-program	1.79	1.81
Sending text messages to a service on Text-TV	1.19	1,19

(*) and (**) indicates significance of difference at $p<0.05$ and $p<0.01$, respectively

From table 4.2 we see in absolute figures, that ordinary text messaging, phone number info, sharing messages and answering services are the services most used and also the services with the highest user intentions. Contrary to the young text messaging users of section 4.1, the negative difference between intention to use ordinary text messaging services and actual use is not significant among these users. However, a negative difference is found in the

intention to share messages with others similar to that found in the text messaging study. For most of the services a positive difference is found between actual use and intention indicating users' intention to increase use of most services the next six months. Of the services with the largest differences between actual use and intentions are services for checking and sending email. For contact services, that these subjects have shown a particular interest in, only a minor difference between actual use and intention to use is observed.

The adoption model for the contact service data is shown in figure 4.2.

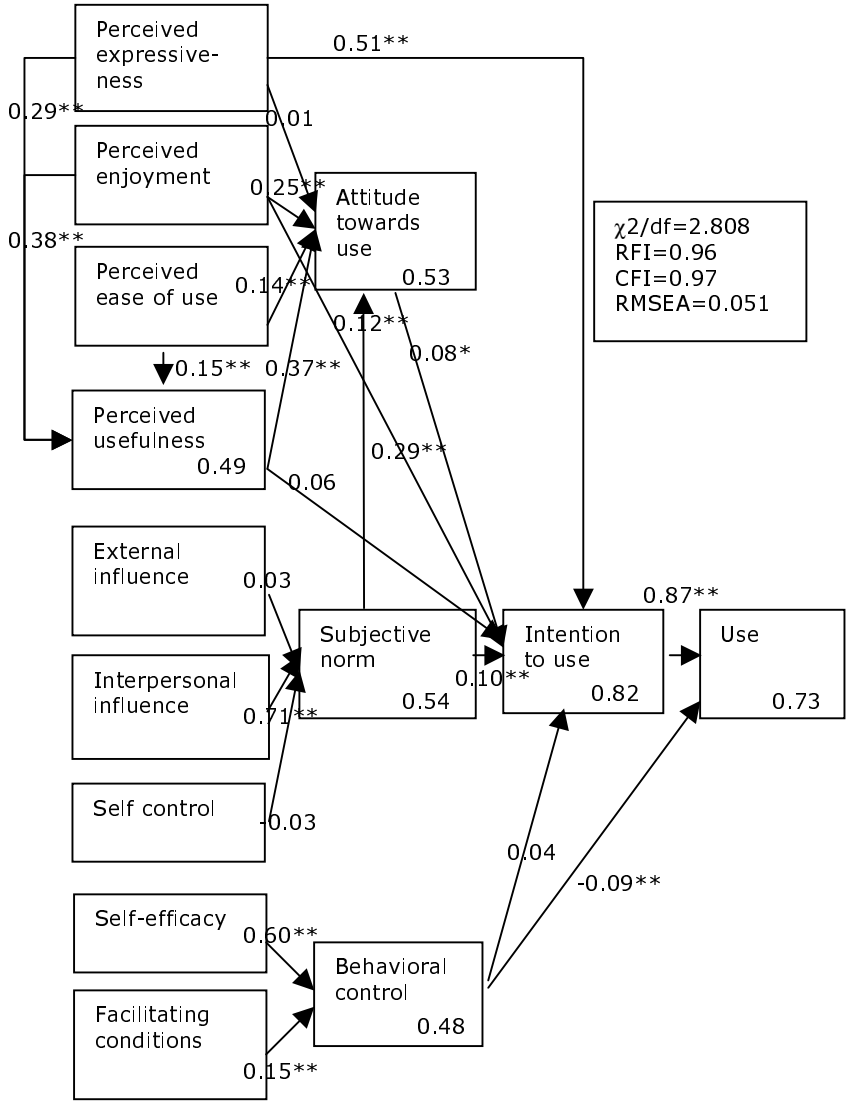

Figure 4.2 Adoption model of contact services

From figure 4.2, we see that the fit of the contact service model is very similar to that of text messaging adoption. We also see that the explained variances are even greater in this model than in the text messaging model. The model explains 82% of the variance in intention to use and 73% of actual use. The same pattern is found in the explained variances of attitudes towards use, subjective norm, behavioral control and usefulness as well. When looking at the standardized regression coefficients, we find that intention to use contact services is influenced by the direct instrumentality of expressiveness and enjoyment, but not by usefulness. Furthermore, intentions are influenced by attitudes towards use and subjective norm, but these effects are only significant at the 5% level or just below this level, and should be considered rather weak when compared to the direct instrumentality effects of enjoyment and expressiveness. In particular, expressiveness is an important instrumental determinant of these services indicating that high volume users of contact services consider these services a part of "the way they express themselves". Behavioral control is not found to significantly influence intentions. Thus, intention to use contact services is mainly explained by the direct instrumentality of enjoyment and expressiveness, and is to some extent influenced by attitudes and subjective norm. This is very different from regular text messaging services and is an indication that contact services are perceived more as entertainment services than utility services. The lack of influence from behavioral control also indicates that these services are not perceived as services needing much facilitation or skills to be utilized.

Usefulness is influenced by ease of use, enjoyment and expressiveness and attitudes are influenced by ease of use, enjoyment, usefulness and subjective norm. Thus, it seems that usefulness is important in the determination of attitudes, but the minor influence of attitudes on intentions indicate that attitudes and intentions are not as closely related for these services as for text

messaging services. Thus, users may be positive towards contact services partly because they perceive them as useful for keeping in contact with other people, but still not use the services to any extent. On the other hand, people that use these services extensively do not necessarily perceive them as useful for actually getting in contact with people, but more as an instrument in being entertained and in expressing themselves. This indicates a separation of the motivational and attitudinal process of contact service users that was not found for users of text messaging services, where motivational and attitudinal processes were very similar and were influenced by similar antecedents. Interpersonal influence is the most important determinant of subjective norm for contact services as for text messaging services, and even though the coefficients are not all significant, a similar pattern between behavioral control, intentions and actual use is found for contact services and text messaging.

4.3 Payment services

Users showing an interest in payment services were exposed to a list of mobile services that was composed of more payment specific items. Thus, comparison of user intentions across text messaging, contact and payment service users is difficult. In table 4.3, the actual use and intention to use the services suggested to payment service subjects are shown.

Table 4.3 Actual use and intention to use mobile services

Variable (N>461)	Actual use	Intention
Use SMS to pay for services on the phone	3.82(-)	3.66(**)
Use SMS to pay for services on the Internet	1.68(+)	2.04(**)
Use mobile purse to pay for services on the phone	2.87(+)	3.36(**)
Use mobile purse to transfer money to others	1.56(+)	2.03(**)
Use mobile purse to pay for services on the Internet, such as:		
Web site entertainment	1.61(+)	1.87(**)
E-zine and web newspaper content	1.52(+)	1.68(**)
Information service content (e.g financial, industry information)	1.44(+)	1.59(**)
Downloading music, video, games or software	1.98(+)	2.46(**)
Personal information management / utility services (PIM)	1.92(+)	2.28(**)
Use mobile purse to pay for ordinary services at the POS, such as:		
Tickets (cinema, bus, concert etc.)	1.70(+)	2.55(**)
Goods from vending machine	1.59(+)	2.34(**)
Flowers (delivery)	1.42(+)	1.89(**)
Music (CD/DVD)	1.80(+)	2.50(**)
Parking	1.28(+)	1.66(**)
Car Wash	1.29(+)	1.59(**)

(*) and (**) indicates significance of difference at $p<0.05$ and $p<0.01$, respectively

From table 4.3 we see that the services currently used most often are using SMS to pay for services on the phone and using a purse on the mobile phone to pay for services on the mobile phone. In Norway, this purse solution is the SmartCash solution by Telenor. When compared to the psychometric measure of actual use and intentions to use text messaging and contact services, all the other services listed generally have little actual use. However, the intention to use several of the services is surprisingly high. We find a significant negative difference between actual use and intention to use SMS to pay for services on the mobile phone. Still, this form of payment is believed to be the most

common, but users have high intentions to use other services as well. In particular, the large difference between actual use and intentions for using purse on the mobile phone to pay for products and services at the POS is interesting. In addition, large differences are observed for using purse on the mobile phone to pay for services on the phone, making payments to others and for downloading content.

The adoption model for the payment service data is shown in figure 4.3.

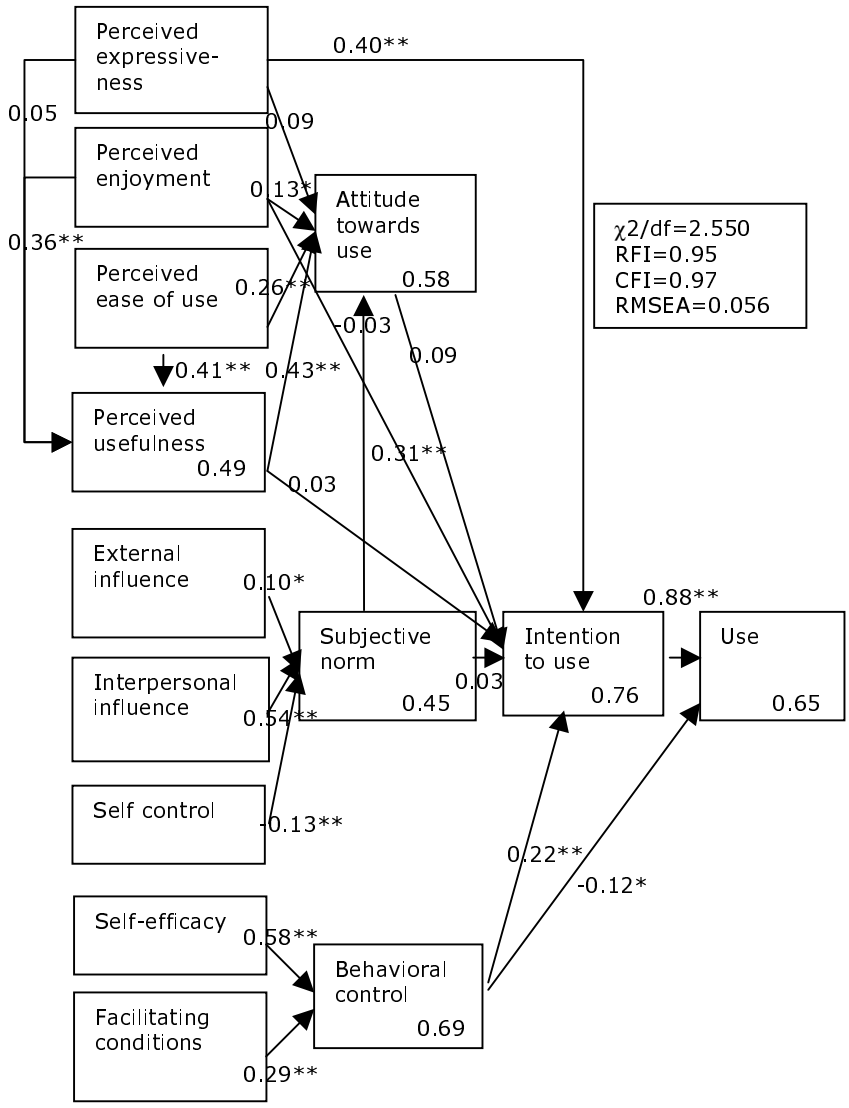

Figure 4.3 Adoption model of payment services

The fit of the payment services adoption model is similar to the two models presented above, and is considered good. From figure 4.3 we find that the model explains 76% of the variance in intention to use payment services and 65% in actual use. For usefulness, attitude towards use, subjective norm and behavioral control, the explained variances are also very similar to those of the previous two models, but the explained variance in behavioral control is as high as 69%. These observations indicate that the fit and explanatory power of the adoption model is very good.

When looking at the standardized regression coefficients, we find that intention to use mobile payment services is explained by the direct instrumentality of enjoyment and expressiveness, but *not* by usefulness. Furthermore, attitudes towards use and subjective norm do not influence intentions, but behavioral control does. Consequently, the instrumental and attitudinal influence on intentions is similar to that of the contact service model, even though the attitudinal part is even less important in the payment services model. This is rather surprising because mobile payment services are generally believed to be instrumental utility services. The influence of behavioral control, however, is easier to understand because mobile payment services require the facilitation of an underlying payment infrastructure as well as user skills. When looking at the determination of usefulness, ease of use and enjoyment are important determinants, but expressiveness is not. Attitudes towards use are influenced by ease of use, enjoyment and usefulness, but not expressiveness and subjective norm. In general, subjective norm seems to have very little relevance in the adoption model of payment services. These findings should perhaps be interpreted in the context of service intentions identified in table 4.3. They indicate that mobile payment services are currently believed to substitute existing SMS-based payment methods. Thus, the usefulness concept of mobile payment services may not have been interpreted as mobile payments being a

substitute of traditional card-based or cash-based payment methods, but as a much more specialized payment instrument. With this contextual interpretation, it is easier to understand the lack of influence of usefulness in the model. However, attitudes are influenced by usefulness, but the attitudinal process does not seem to be integrated in the motivational process, a situation somewhat similar to that of contact services.

As for the other two services, behavioral control is influenced by both facilitating conditions and self-efficacy. However, contrary to the previously presented models, subjective norm is influenced by both external influence and self-control in addition to interpersonal influence. Even though this is interesting, it is of less relevance to the explanation of adoption and user intentions as long as subjective norm does not influence attitudes and intentions.

4.4 Gaming services

Users interested in mobile gaming services were presented a list of entertainment and gaming services accessible using mobile devices. In table 4.4, the actual use and intention to use these services are presented.

Table 4.4 Actual use and intention to use mobile services

Variable (N>197)	Actual use	Intention
Using the mobile phone to get entertaining information (e.g. jokes, horoscopes)	2.06(+)	2.29(**)
Downloading ringtones	2.82(+)	3.10(**)
Downloading screen logos or backgrounds	2.91(+)	3.20(**)
Downloading music or video to your mobile terminal	1.69(+)	2.71(**)
Sending animated or picture messages	2.06(+)	2.97(**)
Using service for chatting on the mobile terminal	2.34(+)	2.81(**)
Using flirt or date service on the mobile terminal	1.39(+)	1.54(*)
Using mobile chat service showing the dialogue on TV or Text-TV	1.34	1.43
Using gambling service on the mobile (e.g. placing bets, lottery)	1.33(+)	1.59(**)
Playing competition based games with monetary gifts or prizes (e.g. quiz)	1.70(+)	2.17(**)
Playing preinstalled games on your mobile terminal (e.g. snake, tetris, solitaire)	4.14	4.20
Playing games by using text messaging (SMS) (e.g. role playing SMS-games)	1.81(+)	2.20(**)
Playing online games using WAP or I-Mode sites	1.88(+)	2.41(**)
Using service for downloading games to your mobile device (e.g. Midletcentral.com, Microjava.com)	2.07(+)	3.23(**)
Playing downloaded games on your mobile device (e.g. Midlet/MIDP games)	2.53(+)	3.61(**)
Playing multiplayer games that let you upload and compare scores online	2.03(+)	2.92(**)
Playing games that let you play against/with players next to you in real time (using e.g. cable, infrared or bluetooth)	2.20(+)	3.23(**)
Playing games that let you play against/with other players online in real time (using your wireless/cell network connection)	1.95(+)	3.05(**)
Playing location based games or games that is played by visiting specific physical locations	1.58(+)	2.38(**)

(*) and (**) indicates significance of difference at $p<0.05$ and $p<0.01$, respectively

From table 4.4, we see that the most used entertainment and gaming services are playing preinstalled games, downloading ring tones and logos, downloading

games and using chat services. The services with the highest user intentions are playing preinstalled games, downloading games, using services for game download and playing games against others. While downloading ring tones and logos and chatting using the phone also have high user intentions, these services have been replaced by gaming services among the services with the highest user intentions. When interpreting these results, one should keep in mind that the gaming study was done among people interested in gaming in an international setting. For example, 39% of the respondents were US-respondents with a very different mobile phone history from European users

When looking at the differences between use and intentions, all differences are positive and most are significant. However, the services with the largest differences are services for downloading games, playing downloaded games, playing games against others over networks and playing downloaded music or video. Thus, an increase in the use of downloaded games and entertainment services is to be expected if these services are being offered.

The adoption model for the gaming service data is shown in figure 4.4.

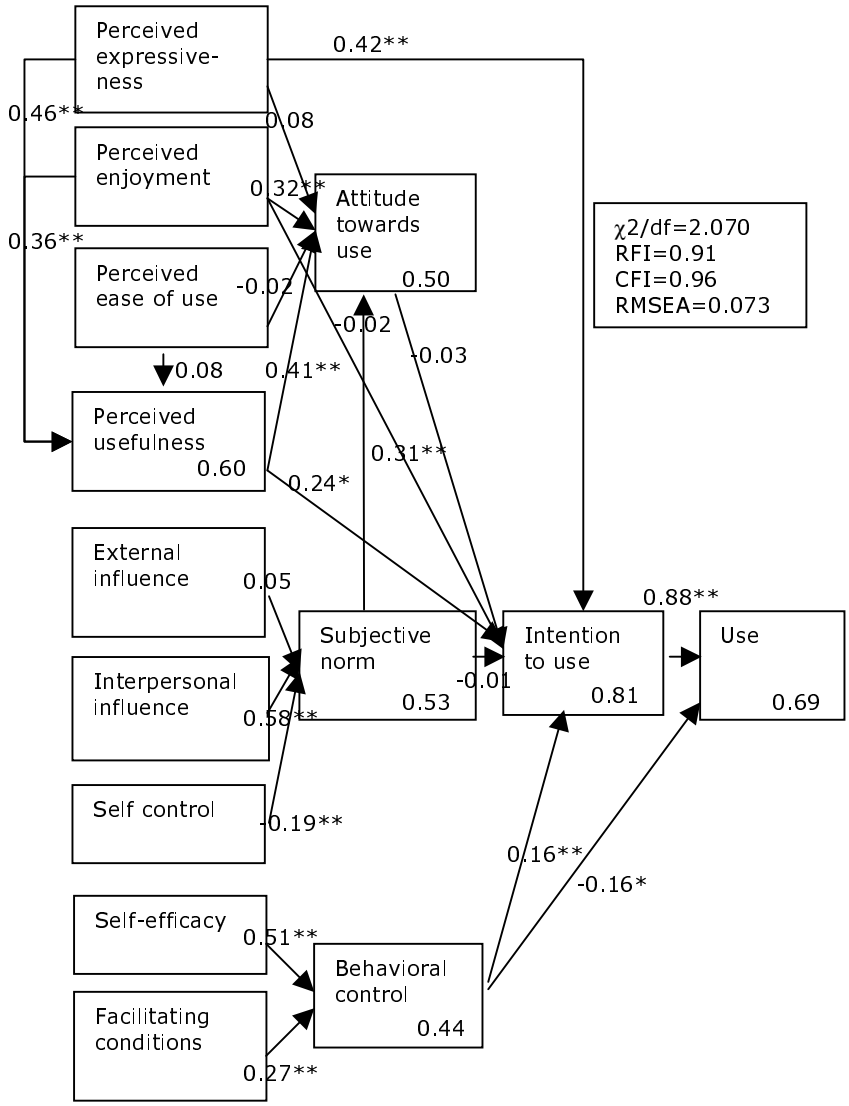

Figure 4.4 Adoption model of gaming services

From figure 4.4 we see that the fit of the model is somewhat different from that of the previous models. It is better when measures by some indexes and worse when using other indexes. However, all indexes are within acceptable intervals, and thus, model fit is considered acceptable. The model explains 81% of the variance in intention to use mobile gaming services and 69% in actual use. For attitude towards use, subjective norm, behavioral control and usefulness, the explained variances are 50%, 53%, 44% and 60%, respectively. Thus, the explanatory power of the model is very similar to the previously presented models.

When looking at the regression coefficients, we see that the direct instrumentality of enjoyment, expressiveness and usefulness all significantly influence intention to use mobile gaming services. We also see that attitudes towards use and subjective norm do not significantly influence intention, and that the influence of behavioral control is significant. From these findings, it seems that intention to use mobile gaming services is influenced by motivational processes and behavioral control only. When looking at the determination of usefulness, we see that only enjoyment and expressiveness influence usefulness. As expected, ease of use is not an issue in either the determination of usefulness or attitudes towards use for gaming services. This corresponds well to our expectations that for gaming services, ease of use and challenge are contrasting, and that perceived challenge is more important in mobile gaming than traditional ease of use. We also see that both facilitating conditions and self-efficacy influence behavioral control, and that interpersonal influence and self-control influence subjective norm. As for contact services, the determination of subjective norm is influenced by self-control. This is an interesting observation, but it is of less importance in explaining the intention to use mobile gaming and more important in explaining the development of subjective norm as such. We also see that subjective norm does not influence attitudes, so there is no indirect influence of this variable on intention to use mobile gaming either.

4.5 Cross service comparisons

Even though the variables of the adoption model were given different operations due to an adaptation to each service context, the same number of items and wording were used. Thus, comparisons of the subjects' perceptions of the variables across services can be made. In table 4.5, we have shown the means and results of tests of analyses of variance of the differences between

means for each of the 14 variables in the adoption model. To simplify comparisons, all variables have been converted to the original 7-point scale used for each item independent of the number of items included in the original multiple measures.

Table 4.5 Means and ANOVA results for all 14 variables

Variable	Texting	Contact	Payment	Gaming	F	Interactions
Expressive-ness	2.4	1.4	2.4	3.0	135.5**	
Enjoyment	4.0	2.1	3.5	5.0	237.8**	sex, serv*sex
Ease of use	5.8	3.7	4.1	5.3	275.9**	sex, serv*age
Usefulness	4.6	2.4	4.0	4.0	261.2**	serv*age
External influence	3.8	3.9	4.0	3.5	4.1**	
Interpersonal influence	3.1	1.7	2.5	3.1	142.0**	
Self-control	2.7	1.9	2.5	2.5	37.0**	sex, age
Self-efficacy	5.7	3.7	4.0	5.2	204.0**	serv*age, all
Facilitating conditions	4.6	3.5	4.0	3.9	63.0**	age, serv*age
Attitudes	4.9	2.6	4.5	4.7	340.3**	serv*age
Subjective norm	3.4	1.6	2.4	2.2	181.9**	
Behavioral control	5.8	4.9	4.5	5.3	56.7**	sex
Intention to use	4.9	1.8	3.5	4.7	412.0**	serv*age, serv*sex
Use	3.1	1.5	2.4	3.6	156.1**	serv*sex, sex*age

(**) indicates a significant difference in at least two means at $p<0.01$.

The figures should be interpreted with care due to sample and context differences. To control for sample differences, analyses of variances have been conducted including main effects of sex and age, and interaction effects of

these variables and service category. The results of these analyses are shown in the "Interactions" column. The figures should be interpreted as absolute level figures, but they are comparable across service categories. Comparisons across variables should be done with even more care. We see that for all variables there are significant differences between at least two means at the 1% level or lower. First of all, we see that the intentions to use the different services are very different. If using the F of the ANOVA as indicator, the most significant differences are found for intention to use. These differences should be generalized with care due to low external validity, but the results are internally valid, and they are rather extreme.

For expressiveness we find the lowest mean for contact services. This figure also illustrates an important issue: Subjects generally perceive the expressiveness of contact services to be low, but in the adoption model its influence on intention to use services was high. This shows how the results of the adoption model and the absolute levels of variables should be combined in the interpretation. What it means is that some users perceive the expressiveness of contact services to be high, and these are the high intention/high volume users, while the majority perceives the expressiveness as being low when compared to other services. These findings also reflect the sample used to study the adoption of contact services because subjects perceive their use of these services as being low. A similar pattern is found for enjoyment, again reflecting the relationship between general perceptions and what influences intention to use a service. However, we also see that except from contact services, payment services have a low absolute level of enjoyment. Ease of use is generally perceived as high in all service categories. The findings for usefulness also correspond well to the findings in the analyses of each adoption model. They revealed that usefulness was only directly influencing intention to use text messaging and gaming services. However, we find that the perceived level of

usefulness for payment services is equally high for payment services. Again, this shows that the usefulness of payment services is perceived as high in general, but the perception of usefulness does not explain intention to use the service. Instead intention is mainly explained by expressiveness, enjoyment and behavioral control. When looking at attitudes towards use, we find figures reflecting the discussion above because attitudes towards use are generally positive for all services except contact services. For text messaging this is important because intentions are attitude driven for this service. This is not the case for payment and gaming services. For operators this implicates that text messaging use should be encouraged using attitudinal information while payment and gaming services should be encouraged using instrumental information (intrinsic and derived motivation) at least among existing users.

The smallest differences in means are found for external influence, and this perhaps reflects the perceptions that there are few differences in the media coverage and influence of mobile services. This is also the case for contact services, even though subjects generally use the lower range of the scales for this service. The absolute level of interpersonal influence reflects the perceived social influence in using the corresponding services. The figures show that the strongest norms are perceived by young text messaging users and gaming users. Naturally, this finding reflects the samples and the interests of the subjects. However, when comparing this to subjective norm, only text messaging is perceived as a subjective norm. When further analyzing the norms we find that for text messaging and mobile gaming, even though interpersonal influence is perceived as high, subjective norm does not explain intention to use the services. Thus, resistance to interpersonal influence is strong, something that is also reflected in the high levels of self-control among these users.

For self-efficacy the figures indicate that users feel they control text messaging and gaming services best. For facilitating conditions, the pattern is somewhat different indicating that users feel text messaging is best facilitated. For example, it seems that users perceive the facilitation of contact, payment and mobile gaming, as low. However, when looking at the adoption models, this is only vital information for payment and gaming services because the behavioral control part of the model only significantly influenced intention to use for these services. For contact services this part is not significant, and thus, perceptions of absolute levels of facilitation are of less relevance. When looking at behavioral control the low perceptions of facilitation is compensated by high skills of gaming users, but this is not the case for payment users.

Because there are sample and context differences in the material, we have investigated the main and interaction effects of age, gender and service. Not surprising, a main effect was found of age for self-control and facilitating conditions. In addition, interaction effects were found of age and service on ease of use, usefulness, self-efficacy, facilitating conditions, attitudes, intention to use and actual use. This means perceptions are dependent on age and service simultaneously, indicating that services are perceived differently in different age segments. For enjoyment, ease of use, self-control and behavioral control, we found a main gender effect, and for enjoyment, intention and actual use we found an interaction of gender and service category. Only for self-efficacy, interactions were found of all three variables, and only for actual use, an interaction was found for gender and age. Even though the interactions should be interpreted with care because we have no observations of older users of text messaging and almost no observations of female gaming users, they indicate that the general perceptions of mobile services are not very different for male and female users and for young and old users when analyzed as aggregates. However, the perceptions are very different among male and female and young

and old subjects when investigating specific service categories. Of most importance are the interactions found for intention to use services. In table 4.6, the mean intention to use each service are shown for male and female and young and old subjects, respectively. Means reflecting the interaction of gender, age and service category are not shown because this interaction effect was not found significant (F=1.30, d.f.=2).

Table 4.6 Mean intentions to use mobile services

	Texting	Contact	Payment	Gaming	Grand mean	F-effect
Female	5.2	1.7	3.5	3.6	3.6	Main F=2.95
Male	4.5	1.8	3.6	4.7	3.4	Interaction F=3.43*
Old	n/a	1.7	3.8	4.7	2.6 (2.7)	Main F=0.04
Young	4.9	2.2	3.3	5.0	4.3 (3.3)	Interaction F=5.21**

(**) and (*) indicates that at least one difference is significant $p<0.01$ and $p<0.05$, respectively.

From table 4.6 we see that there are no significant differences in intention to use mobile services between male and female subjects and between young and old subjects. However, when investigated separately for each service, we see that female users have significantly higher intentions to use text messaging services and lower intentions to use gaming services. We also see that even though there is a large absolute difference between the intentions of young and old users in general (means with text messaging subjects excluded are shown in parentheses), this difference is not significant. However, when looking at the differences for each service category, the difference for both contact and payment services are significant. These perceptual differences also suggest

there may be systematic differences in adoption models across services and across age and gender segments.

In the discussion above we have focused on four influences of intention to use and the corresponding four processes of how the determinants of these influences are developed. The four influences are direct instrumentality (motivational process), attitudinal influence (attitudinal process), social influence (norm process) and resource-related influence from behavioral control (control process). In tables 4.7 and 4.8, these influences and processes are summarized for all the four services investigated. In table 4.7, the patterns of regression coefficients are shown with signs indicating the direction of the influence on intention to use each service.

Table 4.7 Influences on intention to use across services

Influence	Motivational			Attitudinal	Social	Control
	Express-iveness	Enjoyment	Usefulness	Attittudes	Norm	Behavioral control
Texting	++	++	++	++	0	++
Contact	++	++	0	+	++	0
Payment	++	++	0	0	0	++
Gaming	++	++	+	0	0	++

(+) and (++) indicate significance at $p<0.05$ and $p<0.01$

For all models, the motivational influence is dominated by expressiveness and enjoyment. Only for texting and gaming services we find a significant influence of usefulness. As indicated above, this is particularly surprising for payment services, because we expected texting and payment services to be perceived as utility services while contact and gaming services were expected to be less influenced by usefulness. A closer look at the operations of usefulness may

explain some of the findings. Usefulness of payment services has been operationalized in a traditional payment services context while the service analysis revealed a specialized payment service view of mobile payment services. The opposite is the case for gaming services were the operations are closely related to the situation of usefulness for the gamer, not the general usefulness of gaming services relative to other services. This calls for a reinterpretation of usefulness, where usefulness is the perception of time saving, improvement, usefulness and quality relative to the service context, not general usefulness in some absolute term. With this interpretation, usefulness influences intention to use text messaging because it is instrumental in maintaining social relationships, mobile gaming is instrumental in giving access to gaming services, while mobile payment services are currently not seen as instrumentally useful general payment services and contact services are not seen as instrumentally useful replacement of traditional ways of getting in contact with new people. One may ask, however, why payment and contact services' usefulness seems to have been interpreted with the conception of being substitutes while mobile gaming services obviously seem to have been interpreted as complementary services. Part of the responsibility may be found in the context of our measurement contexts, but some of the reason may also be that the complementarities of text messaging and mobile gaming are obvious while this is not the case for payment and contact services.

Attitudinal influence is significant for the communication services and not for the information services. However, this may also have to do with texting and contact services being domesticated services in Norway when compared to mobile payment and gaming services. If this is a valid explanation, it indicates that attitudinal processes are most important for maintaining use rather than initial adoption. Social influence was only found relevant for contact services. We expected a general strong influence of norms on intention to use for all

mobile services, but it seems to be a difficult relationship between instrumentality in maintaining social relations and perceived social influence in use. An interesting pattern is observed in text messaging and contact services. While text messaging services are used because of their functionality in maintaining social relations and because of a general social pressure towards use, contact services are perceived as less relevant for initiating social relations even though a social pressure towards use is perceived.

Finally, intention to use all services except contact services is influenced by behavioral control. This may indicate that facilitation and improvement of user skills are important to most mobile services. Contact services on the other hand may be perceived to be sufficiently facilitated and not require particular skills for use.

Above, the motivational process has been discussed. In table 4.8, the patterns of regression coefficients for the other three processes are shown. In addition, the usefulness determination process is illustrated in the same table.

Table 4.8. Adoption model processes of all four services

Process	Usefulness determination			Attitudinal process			
	Express-iveness	Enjoy-ment	Ease of use	Express-iveness	Enjoy-ment	Ease of use	Useful-ness
Texting	++	++	++	0	++	++	++
Contact	++	++	++	0	++	++	++
Payment	0	++	++	0	+	++	++
Gaming	++	++	0	0	++	0	++

	Norm process			Control process	
	External influence	Interpers. influence	Self-control	Self-efficacy	Facilitating conditions
Texting	0	++	0	++	++
Contact	0	++	0	++	++
Payment	+	++	--	++	++
Gaming	0	++	--	++	++

(++)/(--) and (+)/(-) indicate significance at $p<0.01$ and $p<0.05$ respectively

From table 4.8, we see that generally, the attitudinal, norm, control and usefulness determination processes are surprisingly similar. For texting and contact services, the patterns are exactly the same, showing that all three determinants influence usefulness, that expressiveness has no role in the attitudinal formation process, that only interpersonal influence is relevant in the norm process and that behavioral control is determined by a combination of facilitation and perceived skills. For payment services, expressiveness, that was important in the motivational process, is unimportant in the usefulness determination process. Furthermore, this is the only service where the norm process is influenced by external sources, perhaps reflecting the amount of

information currently found on mobile payment services in media and advertising. For both payment and gaming services, the norm process is influenced by self-control. The sign of the influence is negative, indicating that norms are more developed among users with low self-control. Finally, the role of ease of use in both the usefulness and attitudinal processes is different for gaming services, indicating that challenge is more important for these services than the opposite - ease of use.

To investigate if the sample characteristics of our studies seriously restrict the external validity of our adoption models, adoption models for the contact and payment services may be estimated for different age categories and for male and female users separately. The data from the text messaging study may also be analyzed for male and female users separately. However, all subjects in this study were in the "16-19 years" category and the gaming study had too few subjects and a skewed gender distribution to be analyzed separately. Table 4.9 shows the results of the text messaging model estimated separately for male and female subjects.

Table 4.9 Influences on intention to use text messaging

Influence	Motivational			Attitudinal	Social	Control
	Express-iveness	Enjoyment	Usefulness	Attittudes	Norm	Behavioral control
Female	++	++	0	++	0	++
Male	0	++	++	+	++	++

(+) and (++) indicate significance at $p<0.05$ and $p<0.01$

Table 4.9 shows that direct instrumentality is dominated by expressiveness and enjoyment for female users but by enjoyment and usefulness by male subjects. We also see that subjective norm influences male users' intention to use text

messaging but not female users'. This finding is rather surprising, and may indicate that using text messaging to express oneself is more integrated in the social networks of female users and that the motivations for using it are intrinsic and derived. Among male users, social pressure seems more relevant and direct instrumentality takes a different form. One may speculate if technical elements of the mobile device are maybe used more expressively among male users (Skog, 2002).

Table 4.10 shows the results of the contact services model estimated for male and female, and for subjects above and below the median split of the age variable, separately.

Table 4.10 Influences on intention to use contact services

Influence	Motivational			Attitudinal	Social	Control
	Express-iveness	Enjoyment	Usefulness	Attittudes	Norm	Behavioral control
Female	++	++	0	0	++	0
Male	++	++	++	0	0	0
Young	++	++	++	0	+	0
Old	++	++	0	+	0	0

(+) and (++) indicate significance at $p<0.05$ and $p<0.01$

We find the same differences in direct instrumental motivation for contact services between male and female users as we found for text messaging services. However, the opposite difference is found for subjective norm, indicating that female users experience a social pressure to use contact services while male users do not. Most likely, these differences are indeed service dependent. This is further shown in the differences between young and older users, where contact services are believed to be directly instrumental through

their usefulness for young users, but not for older users. We also see that the social pressure to use contact services is felt greater among young users, and also that an attitudinal dimension in the intention is important for older users. Thus, intention to use contact services among older users is partly determined by their positive attitudes. This is not surprising when investigating the generally negative attitudes towards use of contact services observed in table 4.5. Table 4.11 shows the results of the payment services model estimated for male and female, and for subjects above and below the median split of the age variable, separately.

Table 4.11 Influences on intention to use payment services

Influence	Motivational			Attitudinal	Social	Control
	Express-iveness	Enjoyment	Usefulness	Attittudes	Norm	Behavioral control
Female	++	++	0	+	0	++
Male	++	++	0	0	0	++
Young	++	++	0	0	0	++
Old	++	++	0	0	0	+

(+) and (++) indicate significance at $p<0.05$ and $p<0.01$

The only differences we find in table 4.11 are a significant effect of attitudes for female users and a somewhat lower significance level of behavioral control for older users. These differences are so small that we conclude that there are very few differences in the adoption models of payment services among users of different categories. Based upon these analyses, adoption models seem to be service dependent. It also seems that for some services there are differences between user segments' adoption models. However, we have also found service

categories (payment services) where there few segment differences can be identified.

The final relationship in the adoption models is the relationship between behavioral control, intention to use and actual use. For all services where behavioral control influences intention to use, we find the similar pattern of a positive relationship between behavioral control and intention and a negative relationship between behavioral control and actual use. After careful analysis of the relationship pattern using the components of behavioral control, we have interpreted this relationship as one of perceived deficient self-regulation (Pedersen, 2002). Not surprising, this relationship is strongest for text messaging and gaming services.

5. CONCLUSIONS AND DISCUSSION

This report extends previous research on mobile service adoption from SNF (Pedersen, 2001, 2002). It is based on a modification and re-specification of the theory of planned behavior and includes analysis of the motivational, attitudinal, social and resource-related influence on adopters' intention to use mobile services. In particular, we report how these influences differ across service categories and to some extent user segments. Thus, the main contribution is empirical. Even though the external validity of our results is limited, the model contributes to an improved understanding of the adoption requirements of mobile service users.

5.1 Conclusions

In section 2, we have presented four traditions providing relevant research on the adoption of mobile services; diffusion, information systems, uses and gratifications and domestication research. A model was suggested based upon the theory of planned behavior, but modified and re-specified using findings of mobile service end-user behavior in uses and gratifications and domestication research. The model included four primary influences of adopters' intention to use mobile services. The motivational influence included intrinsic, extrinsic and derived motivations for using mobile services. The attitudinal influence stemmed from motivational determinants and social norms. The social influence was determined by external and interpersonal influence, and was moderated by self-control - the individual user's tendency to resist external and interpersonal influence. Finally, resource-related influence was determined by users' self-efficacy and perceptions of service facilitation. Based upon the review of section 2 and Pedersen (2001, 2002), we suggested a set of propositions on how each of these influences differ across service categories.

The model was tested with empirical data on users' adoption and intention to adopt four different mobile services selected to represent different service categories. Traditional text messaging services and contact services were selected as representative communication services, and gaming and payment services were selected as representative information services. The common model was estimated for each of the four services, and the results common to all services can be summarized as follows:

- The adoption models showed good fit and explanatory power.
- The motivational influence was dominated by the direct influence of intrinsic (enjoyment) and derived (expressiveness) motivations
- Extrinsic motivations of usefulness were context specific
- Social influence was less influential than originally proposed
- Attitudinal influence was less influential than originally proposed
- Resource-related influences were generally important

The general influence of enjoyment and expressiveness as operations of intrinsic and derived motivations was most consistent. Even for services aiming specifically at utilitarian gratifications, the motivational influence of enjoyment and expressiveness was strong and consistent. A surprising finding was the lack of support for a strong social influence on the adoption of mobile services. This indicated that social norms of relevance to mobile services may exist (such as the norm that one should have a well developed social network), but no direct norms of mobile service use seemed to exist that influenced the intentions of users to adopt specific mobile services. The rest of the influences seemed to require a service specific interpretation

The adoption of text messaging services was influenced by all motivational determinants, attitudes and behavioral control. In addition, a relationship indicating that some form of deficient self-regulation existed in the use of text messaging services was found. Contact service adoption was determined by the motivational influences of enjoyment and expressiveness and not by usefulness. This was the only service where social influence was found significant. It was also the only service where resource-based influence was not found significant, and in general, the attitudes towards the use of these services were not very positive. Surprisingly, a similar motivational influence was found for the payment services. This meant that traditional usefulness did not significantly influence the adoption of payment services. In addition, only resource-based influence was found significant. The study of gaming services was conducted in an international setting and the results should be interpreted with care. Still, all determinants of motivational influence were found significant in addition to the resource-based influence.

In addition to the influences of intention to use services, we studied the determinants behind these influences. Consistent with the findings above, usefulness was also determined by enjoyment and expressiveness. As expected, ease of use was important for the perception of usefulness, except for gaming services. While intention to use was not consistently influenced by usefulness, attitudes towards use were. In addition, enjoyment and ease of use were important attitudinal determinants as well, except for gaming services, but expressiveness did not influence attitudes. Generally, subjective norm was determined by interpersonal influence, and only for payment services did we find a significant external influence. Opposing our expectations, self-control moderated norms for the two information services but not for communication

services. These findings generally supported our proposition that adoption models would differ across service categories. However, the theoretically proposed directions of adoption model differences were not consistently supported.

The mean perceptions on each independent variable also revealed interesting differences in users service perceptions. In particular, the general attitudes towards using contact services were not very positive, the mean values of variables not influencing intention to use were found surprisingly high, and the means of some variables influencing intention to use were surprisingly low. This is further discussed in section 4, and indicated that one may be misled by using the mean perceptions of end users as a basis for marketing programs instead of using knowledge of the relationship between perceptions.

Finally, the proposition of segment differences was investigated by focusing on age and gender differences in mean perceptions and adoption models. For mean perceptions, we found differences between male and female users and between old and young users generally supporting our theoretical propositions. Female users intended to use text messaging services more than male users, while the opposite was the case for gaming services. Young users intended to use contact services more than old users, who on the other hand, intended to use payment services more. The general conclusion was that segment differences were service specific, suggesting that service category and segment perceptions interact. A similar finding was made of segment differences in adoption models. For text messaging services, female users' intentions were more influenced by expressiveness than male users, who on the other hand, were influenced by norms. This difference was unique to text messaging services. For contact services, male and young users were more influenced by usefulness, whereas female users were more influenced by norms. Contrasting these

findings, we found almost no segment differences for payment services, supporting the proposition that segment differences are service dependent.

5.2 Discussion

This study includes four individual surveys on mobile service adoption. Consequently, both internal and external validity issues differ across surveys. All studies, however, share a set of measures and procedures that are very similar. In section 3, we presented the procedures and measures applied. In general, all theoretical concepts have been discussed in section 2 or in previous work (Pedersen, 2001, 2002), and are well founded in the research reviewed in section 2. Thus, the construct validity is considered acceptable. Furthermore, the analyses of section 3 showed that measures were reliable and that constructs had acceptable convergence and discriminant validity.

The procedure used to recruit subjects in all studies was similar. In most cases, the subjects took an initiative to participate in the study. In the text messaging study, however, recruitment was not initiated by the subjects. However, our results did not indicate that the selection form applied in this study made our participants different from non-participating adopters. The subjects of all studies were either adopters, or had shown an explicit interest in expressing their opinions on a particular service category. Self-selection procedures did not seem to affect the results in ways that interact with our findings. Samples were in general sufficiently large to guarantee statistical conclusion validity, but the international focus of the mobile gaming study resulted in large variances and a larger sample size would have been desirable in this particular survey. We conclude that in general, the internal validity of our results is considered acceptable. However, internal validity was limited to the constructs, measures, samples and services we have studied. Thus, text messaging services

conclusions were in principle limited to young adopters' use of text messaging services used primarily as a person-to-person communication service. Contact services results were in principle limited to the Internet population of users interested in expressing their opinion on a flirt/chat service provided by A-pressen. Payment services results were in principle limited to prepaid mobile subscribers interested in expressing their opinion on mobile payment services provided by Telenor. Finally, gaming services results were in principle limited to international gaming forum discussants interested in expressing an opinion on mobile gaming in general.

An important issue is how well our conclusions generalize, first to other similar services and other similar segments, and second, across mobile services and segments. Our opinion is that even though the internal validity of our conclusions is generally good, generalizations to similar services and segments should be done with care and generalizations across services and segments should be done most cautiously. Generally, three issues are relevant. To threaten external validity, the subjects, setting or time of the study must be special in a way so that our conclusions do not generalize to other subjects, settings and times. The subjects of the studies differ considerably across studies. In general, text messaging results may be generalized to young adopters, contact messaging results may be generalized to the Internet population, payment services results may be generalized to mobile prepaid subscribers, and mobile gaming results may be generalized to high involved gaming subjects. Generalization beyond these populations is limited. Still, much was done to investigate whether the selection of subjects in our study interacted with our results in ways that limited or strengthened their external validity. For example, many of our analyses were controlled for gender and age differences showing how these variables interacted with service category. This

knowledge may be used to adjust and adapt our results when trying to generalize to similar populations.

The proposition that adoption models differed with service category, and that these differences interacted with segment variables implies that the research design should focus on internal validity, consequently limiting external validity. In addition, questions of representative samples with respect to sample sizes and internal sample variances apply. In our opinion, sample sizes were sufficient to secure internal validity and provide first order generalization (generalization to the population) for all services except for the gaming services study. For this study, generalization is limited. Generalizations across populations are generally not recommended.

The settings applied in our studies were primarily selected to allow generalization to similar service categories. In section 1 and 3, the arguments for selecting our services as representative of information, communication, entertainment and utility services were discussed. It is our opinion that the text messaging, contact, payment and gaming services used in our study were not selected in ways that interacted with our findings so that it is impossible to generalize these results to other mobile messaging, contact, payment and gaming services. Gaming services, however, were studied in a rather general context and thus, generalization may be limited.

Finally, timing also applies to external validity. For example, the stage of development of a service, the phase of the adoption process or external events may have interacted with our service categories and subject selection methods in ways that have reduced the external validity of our results. Text messaging services are now mature services, the contact service studied had been introduced 2-3 months prior to our study, the payment service studied had been introduced 6 months prior to our study, and the mobile gaming services we

investigated were introduced approximately 6-8 months prior to our study (even though very few handsets using these services were available at the time of the study). No particular campaigns other than general marketing were done during or immediately before our studies, and no external events, such as negative media attention or service breakdowns occurred during our study period that we are able to relate systematically to our findings. Consequently, timing is not considered an important limitation to the external validity of our results.

There are several surprising findings and lacks of findings in our study that require further discussion. One of the most important of these was the lack of support for subjective norm as a determinant of intention to use. The typical explanation for this finding is that mobile services are no longer new services in the segments investigated here. Thus, subjective norm may no longer influence intention to use these services. However, we also found differences in the influence of subjective norm by gender and age, and variance in the influence of subjective norm across services. These findings indicate that the influence of subjective norm may be moderated by more than novelty of service technology or media.

When consulting our propositions set forth in table 2.1, we observe that only the minor number of the effects identified in the previous chapters were in fact expected a priori (such as e.g. the limited role of ease of use for gaming services). Several of the propositions of table 2.1 were not supported, and for three of the suggested propositions we found significant results opposing our propositions. In the following paragraph we discuss these opposing findings, relating to the propositions regarding the influence of *usefulness* and *attitudes* and the moderating role of *self-control.* First, *usefulness* was suggested as an important influence of intentions to use services with utilitarian gratifications.

This was supported for text messaging services but not for payment services. We moderated this assumption in section 2 by introducing the concept of context-based usefulness. Context based usefulness was proposed as relative to the intended instrumental gratifications of a service, and replaced the absolute components of usefulness, such as time savings, improvement and efficiency. This may explain why contact services were not found useful in initiating new real contacts and why gaming services were found useful in giving easier access to gaming services. However, further investigation into the conceptions of usefulness as relative to service contexts and intended gratifications is necessary.

Attitudes were proposed to be more influential for novel services because experiential influence, such as that stemming from motivational influence, was unfounded. This proposition was unsupported, and in fact, we found most support for attitudinal influence on intention to use services that were well established (text messaging and contact services). Thus, attitudes may well have been developed towards a service, but attitudinal influence seemed to require user experience. For the communication services, attitudes were found influential and also, attitudes were partly socially determined for these services. This is not shown in table 4.8, but indicated that the attitudinal process may be more different for communication and information services than what was revealed from table 4.8.

Self-control was generally proposed as a moderator of subjective norm. In addition, we proposed that self-control was most important for services where subjective norm was influenced interpersonally. However, we found the greatest moderating effect of self-control for information services like payment and gaming. For one of these services, external influence was also found significant. This implied that the moderating role of self-control was relevant,

but self-control seemed important in moderating subjective norm irrespective of what influenced it. Further analyses of the relationship between external and internal influence and the moderating role of self-control seem required. Behavioral control was proposed to be most influential for complex services, services requiring an underlying infrastructure and challenging services. However, behavioral control was found to be influential for all services except contact services. Lack of influence on intentions for the contact service may be explained by service simplicity, but we also expected this to be the case for text messaging services. When analyzing the relationship between the components of behavioral control further for text messaging services, we found that only the facilitating conditions component influenced intention to use. This supported the finding that young users are currently cost oriented users of text messaging services and that the cost element of facilitation was very important to these users (Grinter and Eldridge, 2001).

Another issue worth discussing is the relationship between mean perceptions and influence in the adoption model. We found surprisingly high mean values for perceived variables on services where these variables were not influential in the adoption model and vice versa. For example, expressiveness was perceived low of contact services but was very influential in the model whereas usefulness had high mean values for payment services but was not significant in the adoption model. Thus, users perceived services as enjoying, useful and expressive even though these variables did not necessarily explain users' adoption. Perceptions did not consistently correlate with intentions to use the services. Furthermore, a service that may not generally be perceived as enjoying, useful and expressive, may still be used primarily by those few that perceive the service as just that. These findings call for more reflection of service providers and developers in attending to the interaction of service category and segments in the determinants of intention to use a service.

However, these findings also limit the implications that may be drawn form our study.

5.3 Implications

When suggesting implications of the results presented above, three findings stand out as very consistent across all studies: The importance of intrinsic and derived motivations, the lack of influence of norms and lack of a consistent relationship between mean values of perceptions and model influences. The importance of intrinsic and derived motivations in adopting mobile services suggests that these gratifications are expected by current mobile service users. Thus, current users expect and require these gratifications to be met by mobile services. This represents a challenge to mobile service developers including service elements to meet such gratifications in services primarily designed for utilitarian purposes. It also has implications for the content distributed by mobile services and for the principles of integrating underlying content. For example, users may expect these gratifications to be met by the content paid for using mobile payment services as well as by the payment service in itself. Even though our findings suggest enjoyment and expressiveness to be consistent requirements of mobile services, interpreting this result should also be done with care. Because of limitations in the external validity of our study, these findings are restricted to interested subjects or adopters. Thus, enjoyment and expressiveness are expected of mobile services, but many such services have not got a widespread adoption, and including enjoyment and expressiveness as gratifications obtained may not guarantee their widespread adoption. For example, users not currently adopting mobile services may have done so because enjoyment and expressiveness are such important gratifications of current service. To reach *new* users, it is not obvious that the same

gratifications should be met. Further research is required to identify differences in the importance of these gratifications to current adopters and non-adopters.

The finding that norm only influenced intention to use contact services was surprising and indicates that both the norm concept and the complexity of mobile service adopters' adoption requirements should be reconsidered by most industry players. First, norms, sociability, fashion and expressiveness are often equated and simplified in industry analyses (see e.g. Computerworld, 2002). Our findings indicate that strong norms towards using mobile services may exist, but in general, these norms do not explain variance in mobile services use. Furthermore, norms of relevance to the adoption of mobile services, such as a norm of having a well functioning social network, may exist. And to demonstrate and obtain social capital of relevance to that norm, mobile services for social network mediation may be used. However, the intentions to use these services are explained by the gratifications of sociability and expressiveness, not by the norm of mobile service use. Thus, the complexity of the motivational and attitudinal influence on intention to use mobile services is underestimated in the simplified explanations often found in industry reports. This is also why we recommend more research into the complexity of the motivational and attitudinal influences of adoption rather than a focus on direct norms of mobile service use.

Finally, the lack of simple relationships between the mean values of perceived concepts, such as perceived usefulness and attitudes, and their influence in our adoption model indicates that results of traditional attitude surveys and usability and usefulness studies may easily be misinterpreted. First, high mean levels of perceived constructs should not be interpreted as importance in the influence of service attitudes or intentions to use services. To most this is obvious, but when comparing mean values across services of success and

failure, it is easy to misinterpret differences in mean values as explanations for the success (adoption) or failure (non-adoption). Our results show that there are no simple relationships between the differences in mean levels of perceived constructs across services and their influence in the adoption model of each particular service. This implies that attitude surveys or usefulness studies should focus on the relationships between perceived constructs rather than comparing perceptions on individual constructs across services. These findings also indicate that the complexity of end-users' adoption models, particularly their motivational and attitudinal processes, is high, and that service specific and segment specific models should be developed that help developers and service providers in their adoption requirement evaluations.

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APPENDIX A

Side **1** av 4

I Norge finnes det nå flere **betalingstjenester på mobilen**. Forenklet deler vi disse inn i:

- **SMS** der du betaler for en vare eller tjeneste med en overtaksert SMS-melding (fra 1 til 30 kroner)
- **Lommebok på mobilen** der du på forhånd har **overført** et visst beløp til mobilen, har gjort avtale om **trekk** fra en bankkonto eller kredittkort, eller har avtalt å få beløpet på en egen **regning** eller på telefonregningen. I Norge er MobilHandel™-SmartCash, SmartPay og TrustedCash/Payex løsninger av denne typen

Vi vil du skal angi om du har **brukt** noen av disse tjenestene **og** om du har **tenkt å bruke** noen av dem de nærmeste **seks månedene**. Hvis du **ikke** har brukt tjenestene vil vi likevel at du svarer på om du har tenkt å bruke noen av dem de nærmeste seks månedene.

Husk å svare i **begge** kolonnene

Angi hvor mye du har brukt og har tenkt å bruke hver tjeneste på en skala fra 1 til 7, der **1 er svært lite** eller **ikke i det hele tatt** og **7 er svært mye**.	Har brukt							Har tenkt å bruke neste seks månedene						
	Svært lite..... Svært mye							Svært lite..... Svært mye						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Bruke **SMS** til å betale for tjenester på/til **mobilen** (f. eks. ringetoner, logoer, informasjon, spill, underholdning)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Bruke **SMS** til å betale for tjenester på **Internett**	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Bruke **lommebok på mobilen** til å betale for tjenester på/til **mobilen** (f. eks. ringetoner, logoer, lade kontantkort)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Bruke **lommebok på mobilen** til å **overføre** penger direkte til andre personer	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Bruke **lommebok på mobilen** til å betale for tjenester på **Internett** slik som:	Svært lite..... Svært mye							Svært lite..... Svært mye						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Underholdning på nettsteder (f. eks. BigBrother, ÅpenPost, Torsdagsklubben)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Innhold på **nettaviser** eller **nettmagasiner**	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Spesielle **informasjonstjenester** (f. eks. finansinformasjon, bransjeinformasjon)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Nedlasting av **musikk**, **video, spill** eller **programvare**	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Personlige nyttetjenester på Internett (epost, kalender, lagringsplass, egen hjemmeside)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Bruke **lommebok på mobilen** til å betale for **fysiske** produkter eller tjenester, slik som:	Svært lite..... Svært mye							Svært lite..... Svært mye						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Billetter (f. eks. kino, konsert, buss)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Varer fra **automat** (f. eks. brus, sjokolade)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Blomster	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Musikk (CD/DVD)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Parkering	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Bilvask	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Fortsett på neste side når du er klar.....

Side **2** av 4

Vi vil at du nå konsentrerer deg om **betalingstjenester på mobilen.**

Svar på spørsmålene ut fra dine **erfaringer**. Hvis du ikke har erfaring med slike tjenester vil vi likevel at du svarer på spørsmålene ut fra det du **vet** eller **tror** om **betalingstjenester på mobilen**.

Vennligst ta stilling til følgende utsagn, der du angir grad av enighet på en **skala** fra 1 til 7 der **1 er svært uenig** og **7 er svært enig**:	Svært uenig 1	2	3	4	5	6	Svært enig 7
Betalingstjenester på mobilen gjør at jeg sparer tid når jeg handler enkelte varer og tjenester	☐	☐	☐	☐	☐	☐	☐
Det er enklere å handle visse varer og tjenester med betalingstjenester på mobilen	☐	☐	☐	☐	☐	☐	☐
Betalingstjenester på mobilen gjør meg til en bedre forbruker	☐	☐	☐	☐	☐	☐	☐
Betalingstjenester på mobilen er nyttige når jeg handler enkelte varer og tjenester	☐	☐	☐	☐	☐	☐	☐
Det forventes at folk som jeg bruker betalingstjenester på mobilen	☐	☐	☐	☐	☐	☐	☐
De som betyr noe for meg forventer at jeg bruker betalingstjenester på mobilen	☐	☐	☐	☐	☐	☐	☐
Folk jeg ser opp til forventer at man bruker betalingstjenester på mobilen	☐	☐	☐	☐	☐	☐	☐

Angi langs en **skala fra 1 til 7** hvordan du, sett under ett, ser på **betalingstjenester på mobilen**:

Dårlig	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7	Bra
Ufornuftig	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7	Fornuftig
Ugunstig	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7	Gunstig
Negativ	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7	Positiv

Vennligst ta stilling til følgende utsagn, der du angir grad av enighet på en **skala** fra 1 til 7 der **1 er svært uenig** og **7 er svært enig**:	Svært uenig 1	2	3	4	5	6	Svært enig 7
Det er lett å lære å bruke betalingstjenester på mobilen	☐	☐	☐	☐	☐	☐	☐
Det er lett å få betalingstjenester på mobilen til å fungere slik jeg vil	☐	☐	☐	☐	☐	☐	☐
Bruken av betalingstjenester på mobilen er enkel og forståelig	☐	☐	☐	☐	☐	☐	☐
Det er lett å bruke betalingstjenester på mobilen	☐	☐	☐	☐	☐	☐	☐
Massemediene er fulle av artikler og nyheter som hevder at bruk av betalingstjenester på mobilen er smart	☐	☐	☐	☐	☐	☐	☐
I medier og reklame finner jeg til stadighet anbefalinger om å bruke betalingstjenester på mobilen	☐	☐	☐	☐	☐	☐	☐
	Svært uenig 1	2	3	4	5	6	Svært enig 7
Jeg snakker ofte med andre om betalingstjenester på mobilen	☐	☐	☐	☐	☐	☐	☐
Jeg viser gjerne betalingstjenester på mobilen til andre	☐	☐	☐	☐	☐	☐	☐
Å bruke betalingstjenester på mobilen er en del av den måten jeg uttrykker min personlighet på	☐	☐	☐	☐	☐	☐	☐
Andre blir ofte imponert over min bruk av betalingstjenester på mobilen	☐	☐	☐	☐	☐	☐	☐

Fortsett på neste side når du er klar.....

Side 3 av 4

Fortsett å ta utgangspunkt i **betalingstjenester på mobilen**, og besvar følgende spørsmål:

Vennligst ta stilling til følgende utsagn, der du angir grad av enighet på en **skala** fra 1 til 7 der **1 er svært uenig** og **7 er svært enig**:	Svært uenig 1	2	3	4	5	6	Svært enig 7
På jobben/skolen synes alle at betalingstjenester på mobilen er noe man bør bruke	☐	☐	☐	☐	☐	☐	☐
Vennene mine synes at man burde bruke betalingstjenester på mobilen	☐	☐	☐	☐	☐	☐	☐
Jeg får stadig anbefalinger fra venner om å bruke betalingstjenester på mobilen	☐	☐	☐	☐	☐	☐	☐
Jeg føler meg fri til å bruke de betalingstjenestene på mobilen som jeg selv ønsker	☐	☐	☐	☐	☐	☐	☐
Jeg har fullstendig kontroll over bruken av betalingstjenester på mobilen	☐	☐	☐	☐	☐	☐	☐
Generelt sett har jeg de midler og ressurser jeg trenger for å bruke betalingstjenester på mobilen	☐	☐	☐	☐	☐	☐	☐
	Svært uenig 1	2	3	4	5	6	Svært enig 7
Jeg har tenkt å bruke betalingstjenester på mobilen de neste seks månedene	☐	☐	☐	☐	☐	☐	☐
De neste seks månedene har jeg tenkt å bruke betalingstjenester på mobilen mye	☐	☐	☐	☐	☐	☐	☐
Jeg har tilstrekkelig tid til å bruke betalingstjenester på mobilen på en smart måte	☐	☐	☐	☐	☐	☐	☐
Jeg har de kunnskaper og ferdigheter som er nødvendig for å bruke betalingstjenester på mobilen	☐	☐	☐	☐	☐	☐	☐
Jeg føler at jeg behersker bruken av betalingstjenester på mobilen fint på egenhånd	☐	☐	☐	☐	☐	☐	☐
Generelt sett ønsker jeg å gjøre det mine venner synes jeg burde gjøre	☐	☐	☐	☐	☐	☐	☐
Generet sett ønsker jeg å gjøre det familie eller kollegaer synes jeg burde gjøre	☐	☐	☐	☐	☐	☐	☐
	Svært uenig 1	2	3	4	5	6	Svært enig 7
Jeg har de økonomiske ressursene som er nødvendig for å bruke betalingstjenester på mobilen	☐	☐	☐	☐	☐	☐	☐
Jeg har det som trengs av teknisk utstyr for å bruke betalingstjenester på mobilen	☐	☐	☐	☐	☐	☐	☐
Betalingstjenestene på mobilen er sikre og teknisk velfungerende	☐	☐	☐	☐	☐	☐	☐
Det teleselskapet jeg bruker tilrettelegger godt for bruk av betalingstjenester på mobilen	☐	☐	☐	☐	☐	☐	☐
Betalingstjenestene på mobilen fungerer fint sammen med de andre betalingstjenestene jeg bruker	☐	☐	☐	☐	☐	☐	☐

Fortsett på neste side når du er klar.....

Side **4** av 4

Fortsett å ta utgangspunkt i **betalingstjenester på mobilen**, og besvar følgende spørsmål:

Vennligst ta stilling til følgende utsagn, der du angir grad av enighet på en **skala** fra 1 til 7 der **1 er svært uenig** og **7 er svært enig**:	Svært uenig 1	2	3	4	5	6	Svært enig 7
Jeg synes det er underholdende å bruke betalingstjenester på mobilen	☐	☐	☐	☐	☐	☐	☐
Jeg synes det å bruke betalingstjenester på mobilen er hyggelig i seg selv	☐	☐	☐	☐	☐	☐	☐
Å bruke betalingstjenester på mobilen er spennende	☐	☐	☐	☐	☐	☐	☐
Det er morsomt å bruke betalingstjenester på mobilen	☐	☐	☐	☐	☐	☐	☐
Sammenliknet med andre bruker jeg betalingstjenester på mobilen mye	☐	☐	☐	☐	☐	☐	☐
Jeg bruker betalingstjenester på mobilen mye når jeg handler enkelte varer og tjenester	☐	☐	☐	☐	☐	☐	☐
Jeg ser på meg selv som en storbruker av betalingstjenester på mobilen	☐	☐	☐	☐	☐	☐	☐
Vennligst ta stilling til følgende utsagn om **mobiltjenester mer generelt** (ikke bare betalingstjenester).	Svært uenig 1	2	3	4	5	6	Svært enig 7
Hvis jeg hører om en ny mobiltjeneste som er kommet er jeg svært interessert i å prøve den ut	☐	☐	☐	☐	☐	☐	☐
Sammenliknet med mine venner bruker jeg mange nye mobiltjenester	☐	☐	☐	☐	☐	☐	☐
Jeg er generelt blant de første i min vennekrets som har hørt om nye mobiltjenester når de kommer på markedet	☐	☐	☐	☐	☐	☐	☐
Jeg prøver ut nye mobiltjenester selv om jeg ikke har hørt om andre som har prøvd dem	☐	☐	☐	☐	☐	☐	☐

Vennligst **besvar følgende spørsmål**:	
Omtrent hvor mange ganger bruker du betalingstjenester på mobilen i løpet av en uke?	☐ ganger
Omtrent hvor mye kjøper du varer og tjenester for med betalingstjenester på mobilen pr. måned?	☐ kroner
Er du kvinne eller mann?	☐ Kvinne ☐ Mann
Hva er din alder?	☐ 0-19 ☐ 20-29 ☐ 30-39 ☐ 40-49 ☐ 50-59 ☐ 60 og over
Hva er din høyeste utdanning?	☐ Grunnskole ☐ Videregående skole ☐ Universitet/høyskole 1-3 år ☐ Universitet/høyskole 4 år eller mer
Omtrent hva er din personlige bruttoinntekt (kroner)?	☐ Under 200 000 ☐ 200 000 - 399 000 ☐ 400 000 - 600 000 ☐ Over 600 000

Husk å fylle ut kontaktinformasjon på foran på undersøkelsen og returner dine svar i vedlagte svarkonvolutt!

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