Acceptance and perceptions of advanced mobile services: Alterations during a field study

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Abstract

Mobile data services have for almost a decade been promoted as the next crux in the mobile communications revolution. However, consumer embracement of data services has been the exception rather than the rule in most western European counties. We conducted a multi-method field study to investigate if user's perceptions of central technology acceptance items change during trials of new m-services. Our preliminary results show significant changes in users' perceptions emerging after trying new m-services.

1. Introduction

While mobile phone penetration rates have increased considerably in many countries (i.e. Norway 90,89%, Denmark 88,72%, Sweden 98,05%, according to ITU's official statistics for 2003), market saturation and intense competition have pushed prices down on traditional m-services such as voice telephony and SMS. In response mobile network operators (MNOs) around the world are forced to find alternative sources of revenue. To counteract decreasing average revenue per user (ARPU) advanced data services, i.e. multimedia-messaging (MMS), video-telephony and walled garden gateway portal services, are often portrayed as sources of remediation. For the time being however, the achievements of European network operators offering advanced m-services over WAP and/or 3G have been pallid relative to the success of KDDI's WAP based Au portal, the (not WAP based) i-mode platform launched by NTT DoCoMO [1, 2] and the rapid current growth of 3G in Japan.

Empirical research on mobile data services has resulted in highlighting the idiosyncrasies pertaining to culture, innovation systems, technologies, strategic approaches [1, 3-5] as well as factors pertaining to individual perceptions of technology [6, 7]. Among end-user studies, individual perceptions of technology along with reports on survey based end-user research and user categorization [8-10] have been predominant. Following the technology acceptance tradition, this type of research in the context of m-services is aimed at measuring latent constructs and confirming structural hypothesized relations (i.e. structural equation models). This has contributed to empirically document the critical success factors of WAP [6], the role of exposure [7] and task-technology fit [11], evaluation criteria for mobile shopping site selection [12], and impacts of location aware advertising [13] in m-service settings. However, inquiries aiming to document the potential malleability and dynamism which may arise as a result of actual and recurring use of new m-services have, to the authors' awareness, not been presented. This is of central importance because dynamism in perceptions may heavily alter first impressions and, as asserted by Takeshi Natusno – one of the master architects behind i-mode - if "you damage subscribers' first perceptions, they never come back to your service" [14].

The underlying assumption of this research is that first-impressions and alterations to these can have a decisive effect on adoption and use of m-services. In this paper we therefore report on perceptions of participants of a field study based on their responses to central technology acceptance parameters that are adjusted to a mobile service setting. Data is collected before and after trials of new m-services, available over a Danish MNO's m-service walled garden platform. The key aspiration of the research is to *provide insights concerning the degree to which initial perceptions are maintained as experiences with new portal based m-services are gained.*

The paper is organised as follows. In section 2 we outline and connect the intentions of this research to the central constructs we draw upon in our analysis of technology acceptance. In section 3 we describe the research approach used for obtaining the data and set the hypothesis. In section 4 we present the analysis of the results and discuss the main findings. Finally, in section 5 we conclude by underlining the main results and highlighting promising avenues for further research.

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2. Technology acceptance items for a mobile service context

Since Fisbein and Ajzen [15] presented the 'Theory of Reasoned Action', models linking cognitive constructs with behavioural intention and actual behaviour have become among the most systematic and extensively applied approaches both in marketing as well as IS research [16, 17]. With eight technology acceptance (TA) models later emerged, Venkatesh and colleagues [17] have recently integrated, conceptualized and empirically validated a unified model (UTAUT). We draw upon the central construct of this research and adapt them to m-service context.

Central challenges emerge when introducing TA research in an m-service context. First, single artifacts with multiple features, e.g. mobile phones, are used in spheres of work and leisure to a larger extent than before. Not only is computing itself envisioned to become ubiquitous or pervasive [2, 18], but so we envisage the potential of technological properties to support the multifaceted contexts of everyday life practices. The advent of mobile phones becoming miniaturized computing devices (i.e. Smart Phones) is an illustrative example where voice, SMS, e-mail, map and location services can all be used across traditionally distinct spheres of life. Consequently, technology acceptance research's traditional domain of organizations is no longer the only sphere of interest, and no longer is there an unambiguously defined artifact.

Second, adoption can be contingent on the properties and availability of complementary products and services, the actual use of other products and services, and even corresponding adoptions by other users, i.e. due to network effects [1, 19] and complementarities. Thus, contingency models may be faced with the challenge of handling multiple-contingencies that may also be interactive and interdependent. This adds dynamism, which can not be sufficiently explained by looking at factors influencing individual or aggregate adoption at single points in time.

In sum, these observations call for (1) adaptation of current technology acceptance research to accommodate a voluntaristic, maybe even pluralistic, mobile service setting, (2) incorporation of temporal aspects which can document malleability over time, and (3) orienting research to enhance our understanding of why potential dynamism occurs as people appropriate single interfaces with multiple life-serving properties.

2.1. Adapting TA research to a mobile setting

Technology acceptance theories have well developed sets of constructs and measurement scales [17] which, together with central constructs from the diffusion of innovation literature [20] can be adapted to m-service settings [21]. The most recent and comprehensive model, the UTAUT model [17], aim to explain and predict technology use behaviour based on five latent constructs (performance expectancy, effort expectancy, social influence, facilitating conditions and intention to use), and four personal difference variables (age, gender, experience, and voluntariness of use). Other latent constructs identified in previous TA research, such as self-efficacy and anxiety, are conceptualized as indirect constructs whereas attitude [22] is considered to operate through effort expectancy. In the following paragraphs we identify, outline and adapt the specific technology acceptance constructs we draw upon in this research.

Performance Expectancy (PE) houses root constructs from other technology acceptance models such as perceived usefulness [23, 24], relative advantage [25], and outcome expectations [26], PE has in previous research appeared as the most robust and single most powerful predictor of intention to use in voluntary as well as mandatory settings [17]. In the specific context PE is defined as the degree to which an individual perceives new m-services to provide benefits in everyday situations [27].

Effort Expectancy (EE) houses root constructs of technology acceptance models such as perceived ease of use [23, 24], complexity [28], and ease of use [25]. In mobile service setting, EE is defined as the degree to which an individual associates ease – freedom from difficulty or great effort [23] – with the conceived use of m-services in everyday usage scenarios [27].

Attitude (ATT) has been found to be the most important predictor of behavioral intentions in some cases, while also been found not to yield significant impact on intentions when performance and effort expectancies have been included in the models [17]. To explore attitudes towards m-services and whether they change upon trial, the construct is included in our measurements to assess an individual's overall affective reactions to their use.

Experience (EXP) with a new technology is considered one of the most central moderating constructs in technology acceptance models. In mobile service settings, prior experience with advanced m-services may have positive (PEXP) or negative (NEXP) moderating effects.

Intention to use (INT) aims to pin down the individual's willingness to perform a specific behavior

[15, 17, 29]. In the specific setting INT is set to measure an individual's intention to use new m-services. Centrally underlying most previous acceptance research is a strong anticipated linkage between intention to use and actual use [17].

3. Research method

3.1. The research setting

The longitudinal multi-method field study was conducted in Denmark from March 2004 to June 2004. The study was undertaken in close collaboration with a mobile operator and a device manufacturer. The overall research aim of the study was to obtain deep insights concerning appropriation processes and central factors influencing the incorporation of new m-services into everyday life and the contextual emergence in use of new m-services.

The Danish market is characterized by approximately 90% penetration rate and an oligopolistic structure. Despite Denmark being among the countries of longest experience with digital mobile communications, 'faithful' appropriation [30] of m-services has predominantly occurred with regular voice services and SMS. 3G services were launched in October 2004. As such, we initiated the field study a few months after this introduction and at the time when non-3G operators in Denmark inaugurated new mobile service platforms (i.e. Fly by TDC Mobile [www.tdcmobil.dk/portal/mobilfly] and e-go by Sonofon [www.sonofon.dk/privat]) as competitive responses to the first moving 3G operator '3' (the brand name for the Hutchinson Whampoa Ltd. 3G [www.3.dk]). Danish mobile communications market exhibits comparable characteristics to the other Western European countries. Although plausible, further research need to be conducted before concluding whether or not the results of this study can be extrapolated to other markets.

3.2. The field study design

We recruited participants which were currently not subscribers to wireless walled garden m-services. Collaboration was obtained by 38 participants of whom 34 provided complete data sets over the four months period. They were part of three different cohorts. Two groups, of 14 participants in each, consisted of graduate students in two separate classes at a higher educational institution in Denmark. The third group consisted of 10 employees working at a Danish public information agency. There was an equal representation of males and females with an average age of 30. The groups were selected carefully as we wanted a field setting in which interaction would occur naturally between participants. Besides, it was important that m-services use was not controlled, but was allowed to emanate in natural social contexts and a voluntary use setting. Furthermore, by targeting a setting of social interactions we offered an arena allowing for knowledge exchange and learning between participants.

We provided the participants with new mobile phones donated by the collaborating handset manufacturer. The handsets were preset with accessibility to the collaborating MNO's new m-services portal (e.g. news, entertainment, email, postcards, downloading multimedia content, chat dating, and location-based information on contemporary events). A fixed prepaid amount was granted, estimated according to participants' reported average monthly mobile payment (e.g. prepaid contract of 35 Euro). The amount could autonomously be spent on mobile communications services of choice (i.e. voice, SMS, MMS and new mobile data services). Despite participants were not using their own money there was thus a real element of budget allocation and financial loss [31].

The measurement tool was based on the literature insights [17] and allowed us to structure and customize a survey collecting data on performance expectancy (9 items), effort expectancy (3 items), attitude (5 items), experience (3 items) and intention to use (4 items). Following suit with Venkatesh et al. (2003), we deployed seven point measurement scales (with 1: completely disagree at the negative end of the scale and 7: completely agree, at the positive end). An overview of the constructs and their corresponding items is presented in Appendix A. For the ex-post measurements, the same questions were asked in a past tense, except for INT 1-3 in order to reflect intentions subsequent to experience.

3.3. The hypothesis

In this paper we report participants' perceptions on main technology acceptance parameters before and after the trials with m-services according to their ratings. Thus, we test the following hypothesis:

H_0: *The participants' perceptions-measures of m-services' acceptance parameters do not significantly differ before and after the trials.*

4. Analysis and Results

We conducted pair-wise t-tests comparing the ratings before and after the trials with respect to the different

items (Table 1). The results inform us that almost all the ratings decreased after the m-services trial period (The average ratings of each item are displayed in Appendix A).

Table 1: Pair-wise t-test results

	Paired Diff. Mean	T	Sig.	p-value	Hypothes. Testing
PE_1^1-PE_1^2	2,12	6,49	0,00	p<0.05	Reject Ho
PE_2^1-PE_2^2	1,97	5,90	0,00	p<0.05	Reject Ho
PE_3^1-PE_3^2	2,09	6,90	0,00	p<0.05	Reject Ho
PE_4^1-PE_4^2	1,50	4,40	0,00	p<0.05	Reject Ho
PE_5^1-PE_5^2	1,03	3,62	0,00	p<0.05	Reject Ho
PE_6^1-PE_6^2	1,79	6,35	0,00	p<0.05	Reject Ho
PE_7^1-PE_7^2	2,00	6,63	0,00	p<0.05	Reject Ho
PE_8^1-PE_8^2	1,26	3,96	0,00	p<0.05	Reject Ho
PE_9^1-PE_9^2	1,50	5,98	0,00	p<0.05	Reject Ho
EE_1^1-EE_1^2	0,79	3,45	0,00	p<0.05	Reject Ho
EE_2^1-EE_2^2	0,79	3,51	0,00	p<0.05	Reject Ho
EE_3^1-EE_3^2	1,21	4,13	0,00	p<0.05	Reject Ho
ATT_1^1-ATT_1^2	1,26	4,50	0,00	p<0.05	Reject Ho
ATT_2^1-ATT_2^2	1,44	5,02	0,00	p<0.05	Reject Ho
ATT_3^1-ATT_3^2	1,21	4,18	0,00	p<0.05	Reject Ho
ATT_4^1-ATT_4^2	1,41	4,35	0,00	p<0.05	Reject Ho
ATT_5^1-ATT_5^2	1,62	6,48	0,00	p<0.05	Reject Ho
$PEXP_1^1$ – $PEXP_1^2$	-0,29	-0,75	0,46	p>0.05	Cannot Reject Ho
PEXP21 PEXP22	-0,38	-1,19	0,24	p>0.05	Cannot Reject Ho
$NEXP_1^1$-$NEXP_1^2$	1,62	3,83	0,00	p<0.05	Reject Ho
INT_1^1-INT_1^2	1,71	5,11	0,00	p<0.05	Reject Ho
INT_2^1-INT_2^2	1,62	4,68	0,00	p<0.05	Reject Ho
INT_3^1-INT_3^2	1,09	3,75	0,00	p<0.05	Reject Ho
INT_4^1-INT_4^2	2,15	6,73	0,00	p<0.05	Reject Ho

Significant change crystallizes for the items measuring intention to use new m-services. In particular, items INT 1-3 show a significant drop in future intention to use new m-services at the end of the project. Hence, the trials appear to have lowered participants' future intentions to use m-services. This is naturally the inverse of what an MNO would find desirable. Reminiscent of the WAP effect in the late 1990s, user expectations become disproportionate to what the m-services actually can offer. Unfavorable market perceptions can not only severely punish first-movers and open opportunities for later movers. In fact, if expectations have been raised by an industry-wide consortium of players, as occurred with WAP, it may lastingly damage the impressions of such technologies by its very name. This may further complicate later introductions, and it may also establish reversion effects if similar experiences are encountered with similar technologies later. This seemed to have occurred among our participants.

Besides, item INT41 was phrased in a past tense to obtain indications on whether or not the m-services available have been incorporated into everyday practices, and, as such, if perceptions have moved from an imaginary state to a state of appropriation. According to Table 1, we observe a significant decrease indicating that this has not occurred to a considerable extent.

In terms of positive experiences with m-services there seems to be no significant change from the low ratings obtained at the beginning of the experiment. This result indicates that neither participants have had considerable positive experiences with new m-services from the past, nor have they been encountered significantly during trials. For recurring use and further diffusion of positively laden m-service communications more positive experiences throughout the study should have been registered. Instead questions of whether or not the right services are offered are called to mind.

In terms of attitude we observe significant decrease in all the items including broader statements such "I (have) welcome(d) new m-services" (ATT3x) and "I (have found) find new m-services amusing" (ATT4x). From this it appears that trials have led participants to less favorable attitudes.

Finally, in terms of performance expectancies and effort expectancies we observe significant decrease in ratings for all (PE1x-9x and EE1x-3x) items, offering indications that services have neither lived up to the expected performance, nor have been providing the ease of use desired. In terms of performance expectancies the significantly decreased ratings of participants after the trials on how m-services could improve and be integrated in everyday life, underline a general disappointment. Furthermore, participants believed that

it would be easy for them to learn to operate, or become skilful to use m-services in day-to-day life (EE2x). However, these beliefs had significantly changed after the trials. Besides, there is a significant difference between expected versus experienced ease of use of new m-services (EE3x).

There are decreasing trends for almost all items of the key technology acceptance parameters. We can thus argue that the relative high motivation and enthusiasm of participants before starting the trial have not been confirmed and maintained during trials. These results indicate dynamism and malleability in user perceptions during the m-service trials period.

5. Discussion and future research

In this article we have reported how measures of perceptions concerning central technology acceptance parameters adapted to an m-service context may alter significantly during m-service trial. We found a general decline with significant bearing when the measurements at the two points in times are tested pair-wise.

The clear indications obtained that user perception of technology acceptance items may alter dramatically during a few months of m-services trials underline a need for applying temporal, i.e. social-psychological and social learning perspectives [20], when studying m-service acceptance and use. From the research findings, it seems plausible to suggest that the reliability of technology acceptance perceptions and their subsequent impact on actual use can be low as users are at an imaginary state; that is, before trial. However, as approaching a more experienced state where contextual use is experienced, a more reliable and realistic acceptance scenario is generated.

We have learned that studying contemporary technology phenomena during their unfolding may demand an alternative research perspective which crosses traditional paradigms and potentially strikes a balance between the rigor and relevance. It has become clear that we are often not able to know whether or not we can observe new phenomena with a perspective that has provided clear portrayals of what worked for understanding currently known phenomena.

With the multitude of m-services made accessible over the single interface of mobile devices, the potential interconnectedness and coexistence of multiple appropriation processes for individuals at corresponding as well as divergent stages of 'maturity' should be accounted for. For instance, there may be important feedback effects from appropriation moves made towards a certain m-service that leads appropriation moves towards another as well as similar effects from related reference technologies such as Internet services.

In this, process considerations from diffusion research (knowledge, persuasion, decision, implementation and confirmation) can benefit from integration with the more socially focused adoption, consumption and practice oriented processes outlined in domestication research [32-35]. This suggestion may open for better understanding of what occurs before as well as after an adoption decision; the preconditions and consequences of the decision process. Although both diffusion research and domestication research suggest a stage-wise progression, a coupling between these and items of technology acceptance can, facilitate understanding of how the items can both enable and constrain progression as well as digressions in the overall m-service appropriation process. This can thus enable better understanding of how and why the perceptions of the technology acceptance items alter as the appropriation process unfolds, or come to an end.

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APPENDIX A

Items	Bef.	Aft.	Performance Expectancies
PE1	5,44	3,32	New m-services will be useful in my everyday life.
PE2	4,79	2,82	New m-services will support my lifestyle.
PE3	4,76	2,68	New m-services will make me accomplish everyday tasks more quickly.
PE4	4,47	2,97	New m-services will improve my communication with family peers and friends.
PE5	4,29	3,26	New m-services will make my everyday more entertaining.
PE6	4,15	2,35	New m-services will make me more updated on things going on in the world.
PE7	5,12	3,12	New m-services will provide me more independence of time and space.
PE8	3,74	2,47	New m-services will improve my social relations.
PE9	4,06	2,56	New m-services will make me to accomplish more in my day-to-day life.
			Effort Expectancies
EE1	5,26	4,47	Learning to operate new m-services will be easy for me.
EE2	5,03	4,24	It will be easy for me to become skillful at utilizing new m-services in my day-to-day life.
EE3	4,91	3,71	I will find new m-services easy to use.
			Attitudes
ATT1	5,44	4,18	Using new m-services is a good idea.
ATT2	5,68	4,24	I find new m-services interesting.
ATT3	5,74	4,53	I welcome new m-services.
ATT4	4,76	3,35	I find new m-services amusing.
ATT5	5,41	3,79	I will enjoy using new m-services.
			Experiences
PEXP 1	2,68	2,97	There are many good m-services I have used in the past
PEXP 2	2,56	2,94	I have found m-services in the past that have helped me in my day-to-day living (other than voice & SMS).
NEXP 1	4,82	3,21	I have had negative experience(s) with m-services in the past (other than voice & SMS).
			Intention to use
INT1	5,65	3,94	I intend to use new m-services over the next month.
INT2	5,65	4,03	I predict I will use new m-services over the next two months.
INT3	5,74	4,65	I assume I will use new m-services over the next 3 months.
INT4	5,24	3,09	I believe that more m-services will become part of my everyday mobile phone use over the next months.