User Experience of Digital News:
Two Semi-long Term Field Studies

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ABSTRACT

Reading of digital news on personal devices has dramatically increased. Parallel to new devices, novel services and content types are created forming new habits and experiences for readers. Previous research is limited in understanding temporal aspects of such users' experiences (UX). This study aims to understand UX of mobile news reading in a real context of use over one week in two different case studies. UX of digital replicas, browser optimized versions of digital news, and a novel media authentication method for news reading and ordering were explored with actual news readers (N=36) in field using their own tablets and personal computers. Data-collection included daily diaries with UX questionnaires, and retrospective interviews. The results showed that the studied forms of digital news and authentication method provided positive UX, and they were appealing for future digital news. UX also showed a tendency of improving over a time. The user's habits of reading digital news reflected the conventions of reading a print newspaper.

Author Keywords

Digital news; reading; browser; digital replica; authentication; user experience; online; tablet; computer.

ACM Classification Keywords

H.5.1 Multimedia Information Systems: Evaluation/methodology.

INTRODUCTION

More and more digital news are read using smartphones and tablets. For example, in Finland, the news reading via smartphones and tablets is growing fast while the computers are still the main source for digital news reading [41]. Nowadays 49% of these readers reach news on at least two digital devices [41]. The different platforms of digital newspaper delivery are especially important in countries with small population and long distances in

physical news distribution [41]. To stay updated with the needs for digital news reading in a way that is beneficial for both media companies in the competitive business landscape and end-users with multiple options for news reading, research on user experience plays a key role.

Digital news is a collection of news delivered via Internet that may include multimedia elements [14,25,45]. There are numerous of forms of digital news, such as news web services, online news portals, digital replicas, tweet feeds by news organizations. One of the essential differences between these forms is the way they support end-user's devices. This paper focuses on digital replica and browser optimized version of news. Digital replica is the earliest form of digital news [8]. It is similar to a standard print newspaper uploaded onto a website by using for example PDF technology. The format does not support interaction, personalized content or layout. It is the most useful for news reading on laptop and desktop computers. Browser optimized version of digital news, one of the latest forms, presents the up-to-date content on websites with interactive elements (incl. content, layout subcategories, menu bars as navigation elements) scaled according to browser of end-users' devices. This form is beneficial for the devices with small-sized display like tablet computers.

There are only a few previous studies published on digital news reading using long-term assessment [3,16,18,24,47,48]. However, the majority of these studies have studied news recalling rather than user experience (UX) of digital news solutions, they have been carried out in controlled circumstances with limited external validity, or no evaluation of UX is done with a measurement scale.

The goal of this study is to understand user experience of mobile news reading in a real context of use over a week long period in two different case studies. The aim of the study is to support the news organizations in developing their services and solutions to better serve their customers' needs and develop the user experience of their solutions. The first study explores user experience of tablet browser optimized forms of newspapers. The second study focuses on UX of digital replicas and an authentication method for enabling news reading with paywalls, for example, therefore contributing to UX. For academics and practitioners, this paper contributes new knowledge on how UX develops over time in digital news reading in the real context of use.

RELATED WORK

User experience and long-term assessment

User experience (UX) is formed when a person interacts with a product. It is influenced by the characteristics of the user, system, and the context of use [21,44]. UX is described as subjective, situated, complex and dynamic [21]. In longitudinal UX studies, the data is collected over time, for example over a week or even a year [15,49,50]. Long-term or longitudinal UX studies look beyond the initial first experiences when taking a system or product into use [32]. Longitudinal UX studies can address transitioning from novice to expert users, include aspects on how UX evolves over time [26], or how positive or negative momentary experiences influence the UX [43].

Longitudinal measurements are considered beneficial as they predict UX over product life cycle in a more reliable way than momentary measurements, and better prediction can save monetary resources [32,43]. Although the value of the long-term UX studies is widely recognized, they are still rarely used [9]. One of the reasons can be that they are burdensome on the participants when subjective measurements are used, and require commitment. They also require more effort from researchers and practitioners than momentary measurements of UX.

According to a literature review of methods used in empirical studies of UX, three most popular data collection methods have been questionnaires (half of them self-developed), semi-structured interviews and live user observation [9]. Half of the reviewed studies used qualitative methods, a third quantitative and the rest (17%) used a combination of qualitative and quantitative methods [9]. When reviewing the methods collected to "All about UX" site to be used in measuring especially long-term user experience [2] the following was observed. 84 methods were listed and 29 of them were categorized specifically for the long-term user experience [2]. Most of the reviewed methods in user experience studies based on both of these sources are used widely in HCI studies. For our study we chose the following methods covered in the previous sources: 1) AttrakDiff2-SF [20], 2) Diary study and 3) Semi-structured interview. We used these methods in our studies based on the following strengths.

AttrakDiff 2-SF has been validated and used widely in a number of studies. It measures effectively user's impressions in dimensions of pragmatic, hedonic and appeal [20]. As our aim was to include different aspects of UX in our studies and it has been used in momentary studies of UX of digital news (e.g. [7]), we chose to use it in our study. In addition we chose to use I-PANAS-SF in our studies for affective reactions similar to Aranyi et al. [7] for digital news reading. A diary study is often a questionnaire with open questions and filled multiple times. Its strengths include reports of daily lives, minimized retrospection and temporal effects characterization [11]. On the other hand they are laborious for both a researcher and a participant [11]. A semi-structured interview covers central set of themes with each participant. Participants have an opportunity to raise important issues. Its strengths are the possibility to use at any phase, giving richer data than questionnaires, and it does not need as much preparation [27] and downsides its consumption of time and possible lack of anonymity [27].

Digital news

Reported research on long-term studies on user experience of digital news is scarce. One of the most recent studies reports results from a six week study with 60 participants [18]. It was carried out in real life usage context in April-May 2013. Participants used tablet devices to read digital replica of the printed newspaper in remote areas of Finland with delayed afternoon delivery of the printed newspaper [18]. User-defined attributes describing participants' experiences were categorized to the following groups: instrumental, sensory, cognitive and epistemic, as well as behavioral and motivational experiences. Furthermore, descriptions of experiences related to lifestyle and impacts were identified in the interviews. Results illustrate the diversity of experiential aspects related to digital news.

To our knowledge, only five other previous studies address the long-term user experience of news websites. They all studied the user experience of websites of news [3,16,24,47,48]. All except one [24] studied the news recalling differences between digital and print news of university students in laboratory context. Some of these studies had an independent control group outside laboratories and guidance but the results were not reported [3,47]. The only study including real life context of use in the study used cross sectional, not a real long-term method [24]. They report that audience tends to read the online newspaper more often, reading especially updated or local news to stay updated on news [24].

The closest to our study about users' experience of digital news are the studies of Vaughan et al. [48] and Aranyi et al. [5,6,7]. Neither of them, however, measured long-term user experience. Findings by Vaughan et al. [48] showed that exposing users to new designs for single trials or sessions may fail to reveal important dynamics in the user response to technology that occur with repeated exposure.

Aranyi and van Schaik [5,6,7] report on user experience of digital news based on exploratory, modelling, and experimental phases. The authors suggest as the components of interaction experience for news sites the following: 1) perception of instrumental qualities, 2) affective reactions, and 3) perception of non-instrumental qualities [6,7]. With an independent-measures experimental design in a laboratory setting between-subjects Aranyi and van Schaik [7] found that especially for the novice users the non-instrumental aspects (like enjoyment and perceptions of hedonic quality) of interaction with news sites may play an important role in users' experience. We apply the measurement model from these studies for our study of user experience of digital news over time.

In sum, semi-long term studies of user experience of reading digital news are lacking and can potentially increase the understanding of experiential aspects and their forming, and further leading to adoption. This information can be used in designing and developing the user experience of digital news reading by news organizations.

Authentication

When accessing digital news and multiple media products on multiple devices, reliable authentication is needed for supporting novel reading patterns, and to access the services behind a paywall and to buy new products, for example. Authentication is a process where a person's identity is verified. A rightful user can after successful verification access the resources allowed to him/her [31,37,42]. In the case of digital news, the rightful users are news consumers, and the resources are the digital news products they have purchased. Previous work on authentication with media products to our best knowledge is scarce. The most relevant example is a short-term laboratory study about the usability of login process in mobile phones [19]. Otherwise the studies of authentication with real users has focused on phishing the passwords (e.g. via email in [30]) or how users use their passwords including for example reuse and recycling of them (e.g. [17,23]).

Halpert (2005) tested three websites for the usability of login process (authentication) in mobile phones with Cognitive walkthrough and Think-aloud protocol with three test subjects and four tasks in a laboratory environment (Halpert 2005). For example, an outcome of the evaluation is that the better the design of the authentication site, the faster the login into an account link was located and selected. The results indicate that the authentication can contribute to the usability and UX of mobile web sites. In traditional systems the user's identity is verified by checking a password typed during login, the system then records the identity, and uses it to determine what operations may be performed [37]. Password based authentication may be a cumbersome approach to the user. It is therefore important to examine authentication as part of user experience of news reading. To our knowledge no prior long-term evaluations of authentication solutions have been carried out in real life context. As authentication is often part of reading digital news, it can contribute to user experience and is of interest to us.

STUDY 1 – TABLET BROWSER OPTIMIZED VERSIONS

Method

The goal was to explore the user experience of tablet browser optimized versions of a regional newspaper in Finland with an expert evaluation and a two-week user evaluation. In user evaluation each participant used two different versions, each for one week.

Expert evaluation

Heuristic evaluation was conducted with five usability experts [39]. The experts rated a total of 29 heuristics (collected from [10,22,33]) by their severity from 0 to 4 retrospectively and independently (according to [38]). The final list is presented in [40]. In the analysis, the usability issues were combined and overlapping findings meanings were merged. In analysis, frequency and severity of problems were summarized.

User evaluation

Participants - A field study was conducted with actual users of digital news in their own everyday life context. 19 active readers of a local newspaper (Keskipohjanmaa) and owners of an iPad completed the study. The participants were 18-65 years old (M=40; SD=12.3) and native Finnish speakers. The number of male participants was 12. The users were rewarded with free usage of Keskipohjanmaa's tablet version for the rest of the year. Interviewed participants received also a 20 euro gift token.

Browser optimized versions of digital news - The three different tablet browser optimized versions of a local newspaper (Keskipohjanmaa) were implemented (Table 1). The version are named as KPK (Keski-Pohjanmaan Kirjapaino Oyj), Aalto (Aalto University) and Metropolia (Metropolia University of Applied Sciences) referring to the organizations behind the implementations. The versions differed in their interaction, design and implementation.

Aalto's version took its content directly from the editorial system of the newspaper. The user interface (UI) of this version was designed by the students of the Aalto University and implemented by a researcher participating in the same project. KPK's version took content from a database of editorial system, and this database offered RSS feed for Metropolia's version. KPK version took inspiration from design student's proposals, but was developed independently. Metropolia's version for layout, structure, navigation, interaction etc. was designed and implemented independently.

The selection and starting order of the tested versions were randomized and equally stratified between age groups and the genders as follows: The participants were divided into three age groups: 18-30 (4 users, 2 male), 31-44 (8 users, 4 male), and over 44 (7 users, 6 male) year-olds.

Context of study - The versions were provided daily for the users to be used in their own tablets (Apple iPads) for one week in their daily life. All participants used altogether two versions, one at the time for a week. The study was carried out in the central Finland, during the summer 2013.

Procedure - The data was collected in four parts as illustrated in Figure 1: 1) A pre-study questionnaire, 2) Diary questionnaires daily and a summarizing retrospective post-study questionnaire 3) Similarly during the second usage period diary and post-study questionnaire, and 4) After the both usage periods an interview and final questionnaire was conducted.

Data-collection methods – Questionnaires and a semi-structured interview were the main data-collection
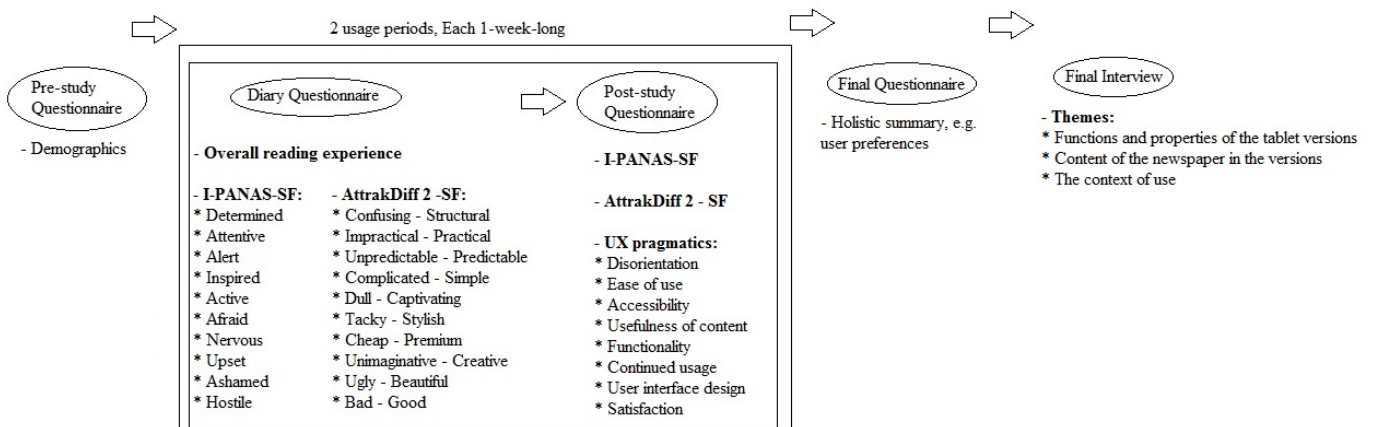
Figure 1. The procedure and the measures of the study 1.

methods. The questionnaires aimed at understanding the multiple dimensions of UX over time while the interview focused on more holistic aspects of UX (see Figure 1 and [40] for original questionnaires and interviews). To evaluate UX during and after a week, the I-PANAS-SF [36], the AttrakDiff 2-SF [20] and wider scale for UX pragmatics (collected selectively from [1,12,52]) were filled on 7-point scale (see Figure 1). After the study, the 0.5-1 hour semi-structured interview, carried out 11 of participants (7 male), consisted of main themes as follows: Functions and properties of the studied tablet versions, content of the newspaper, context of use.

Analysis – Descriptive statistics and non-parametric methods of analysis, suitable for analysis of ordinal related and unrelated data, were used in order to compare the differences in the user experience between the versions tested. Interview data was first transcribed, and then analyzed according to the Grounded theory [46]. To improve reliability the analysis was reviewed by two independent researchers.
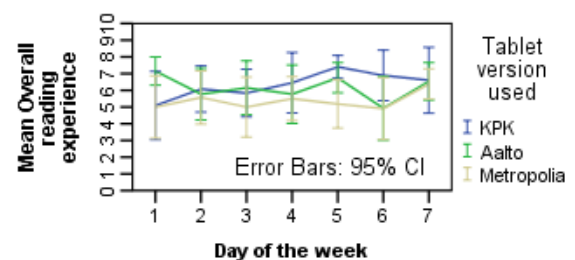
Results

Heuristic evaluation
The evaluated browser optimized versions of digital news differed in quality, frequency and number of usability problems. The highest number of usability issues with the lowest level of severity causing major usability problems or catastrophes was identified for KPK version (64 problems, 43% with severity 3-4). Other two versions contained a lower number of errors with a higher level of their severity (Aalto: 56 problems, 56% with severity 3-4; Metropolia: 38 problems, with 61% severity 3-4). KPK's version broke only two heuristics: 1) Uniformity and navigation and 2) Usability: Orientation, while Aalto's and Metropolia's versions also in 3) Accessibility: Legibility and readability, and 4) Usability: Touch screen ergonomics (Table 1). In summary, Metropolia's version seems to have slightly lower usability compared to other versions tested.

User evaluation
Retrospective evaluations – After use of one week, the results of final questionnaire showed that overall reading

experience was the most pleasant with Aalto's version (9/14), followed by KPK's (5/11) and Metropolia's versions (3/12). When analyzed in more detail, all tablet browser optimized versions were experienced on the same level providing slightly positive experiences to the users on the dimensions of affect, pragmatic and hedonic quality, appeal and user experience pragmatics. There were no significant differences between the versions (I-PANAS-SF; the AttrakDiff 2-SF; UX pragmatics Kruskal-Wallis: $p > 0.05$ for all measures; Figure 3- Figure 7) and the mean values were only slightly positive in all these categories (Mean 3.9-5.8, Cronbach's $\alpha > 0.7$ for all used measures).

Figure 2. The overall reading experience of the tablet versions.
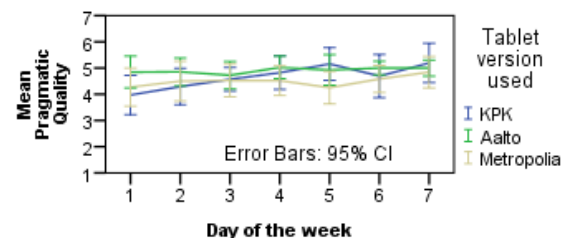
Figure 3. The pragmatic quality of the tablet versions.

During the usage – The results show a tendency that UX measured on different dimensions is slightly improving over time. When comparing overall experiences on a day-by-day basis, KPK's and Aalto's versions outperformed Metropolia's version (pairwise comparisons p<.05), although the mean values were slightly positive for all versions (Mean 4.9-7.4; Figure 2). In detailed analysis, KPK's version evoked slightly more positive affect than the

other two versions (Kruskal-Wallis: p < 0.05; Mann-Whitney U: p < 0.05; Mean: 3.6-4.7; Figure 6). Metropolia's version was experienced to be significantly lower than Aalto's in Pragmatic quality but worse than the other two in both Beauty and Goodness (Kruskal-Wallis: p < 0.05; Mann-Whitney U: p <0.05; Figure 3-Figure 6), when overall the mean values varied between 3.6-5.4 (Cronbach's α > 0.6). In sum, during the usage period the overall reading experience of the tablet browser optimized versions was pleasant, they provided positive affect on users having also positive pragmatic, hedonic and overall quality. However the Metropolia's version provided the lowest user experience out of these three versions during the week.

First vs. the last day – There is a tendency in some of the dimensions that the users experience the tested versions improved when the first and the last days of use were compared. KPK's version improved by 0.9-1.5 in all dimensions except in the positive affect (0.1). Similarly, Metropolia's version had increasing (0.2-1.4) in all measured dimensions except in positive affect which decreased a little (0.3). Finally, the Aalto's version increased only very slightly on negative affect, pragmatic quality and appeal (0-0.2) but it also decreased in the overall reading experience, positive affect and in the hedonic quality (0.5-0.7). In all tablet versions the negative affect, pragmatic quality and appeal slightly increased (KPK and Metropolia 0.3-1.2; Aalto 0.0-0.2) over time.

Impressions about the versions – Inspiring and irritating factors were collected from participants' text input from daily diary and after usage questionnaire. During the use, all versions had close to similar amount of inspiring factors n_{KPK}=78, n_{Aalto}=90, $n_{Metropolia}$=76). All the versions had good pictures and users easily adapted to use. Altogether the inspiring things mentioned by the users about the tablet browser optimized versions could be divided into seven categories: Navigation, Appearance, Features, Functions, Content, Usage and Availability. Metropolia's version collected the highest number of irritating things (5% of mentions) compared to other versions. The irritating factors included in seven categories: Content, Availability, Browsing, Features, Appearance, Functioning and Usage. After the use he users' summary impressions included only two categories (> 40%, n_{KPK}=11, n_{Aalto}o=14, $n_{Metropolia}$=12) per a tested version. Aalto's and Metropolia's versions had only the positive ones (easy to use and clear) while KPK's version had one of the positive and one negative category (easy to use and technical difficulties). All the tested versions were considered somewhat easy to use; with the KPK's version users had some technical difficulties while Aalto's and Metropolia's versions were clear.
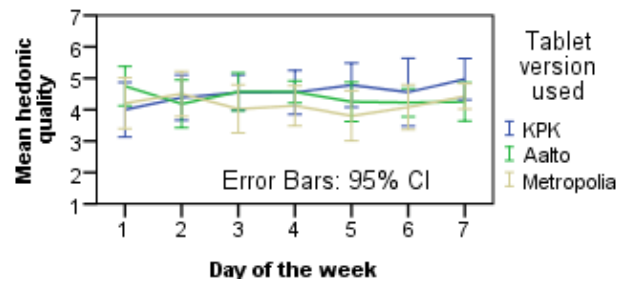

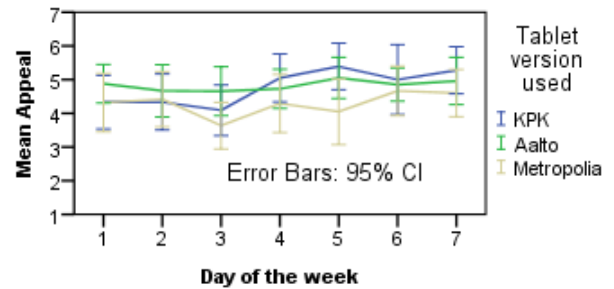
Figure 4. The hedonic quality of tablet versions.
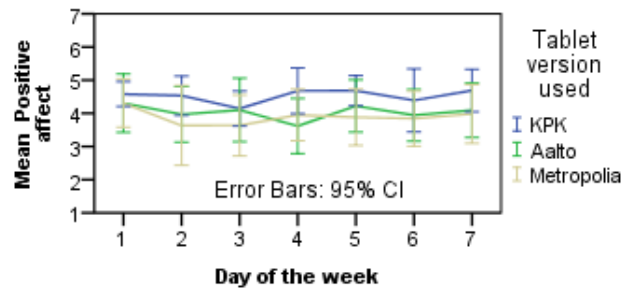

Figure 5. The appeal of the tablet versions.

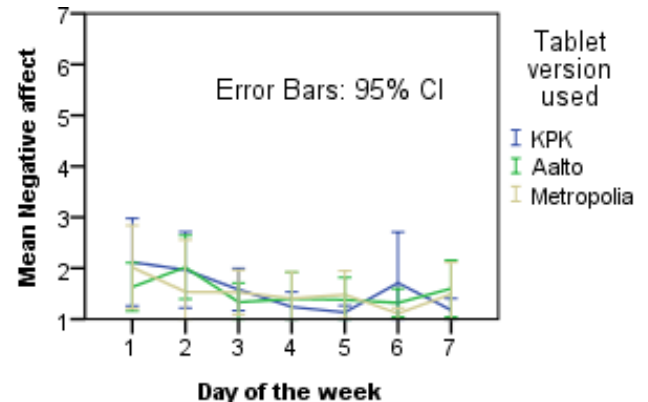**Figure 6. The positive affect of the tablet versions.**

Figure 7. The negative affect of the tablet versions

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Table 1. The comparison of users' opinions during and after the usage.

	KPK	AALTO	METROPOLIA
Browser optimized versions			
Expert evaluation — Usability problems	- Problems with offering navigation clues to users, Crashed the browser of a tablet while its orientation was changed and Too small Close article –button	-Problems with offering navigation clues to users, Problems in visualizing the functions of the user interface and It was confusing what article is going to be shown next	- Problems with offering navigation clues, Uniformity in navigation functions, Unsmooth UX, Visual quality differed (mood/brand) from print newspaper, Theme names were missing, unstable background colors and Hidden zooming function
User evaluation (retrospective interview) — + Inspiring (> 5%):	+ Pictures, Layout, Visually pleasing, Starting page, Fast loading page, Logic, Fast to use, Got used to it	+ Pictures, Simplicity, Clarity, Layout, Visually pleasing, Functioning, Interesting articles, Got used to it	+ Pictures, Colors, Simplicity, Clarity, Functioning, Interesting articles, Fast to use, Got used to it
- Irritating (> 5%)	- Horizontal scrolling, Messy, Browser crashed, Loading problems	- Lack of content, Missing content, Visually unpleasing, Small font	- Missing content, Not fluent browsing, Bad starting page, Messy, Visually unpleasing, Differs from brand, Not newspaper-like
+ Strengths (> 50%):	+ Newspaper like, Clear, Good pictures, Zoomable, Swiping worked, Had more content	+ Newspaper like, Clear, Good colors, Good navigation bar, Easy to use	+ Good colors, Good pictures, Back-button for returning the home page
-Weaknesses (> 50%):	-	- Bad colors, Problems with zooming, Bad navigation bar, Lack of content, Confusing greying	- Not newspaper like, Confusing, Bad colors, Lack of content, Not enough content

In the final interview, the users described (n=8, > 50%) the biggest amount of positive categories (6 "strengths") to the KPK's version with no negative ones (0 "weakness") which differed from the descriptions of the other two tested tablet browser optimized versions (strengths$_{Aalto}$=5, strengths$_{Metropolia}$=3, weaknesses$_{Aalto}$=6, weaknesses$_{Metropolia}$=5; see Table 1).

Usage context – The analysis included in all mentions from the daily diaries from the both usage weeks. When reading the tablet was reported not to be held with hands (35%, n=240). When using one hand holding strategy, the left hand was usually chosen for holding, and the device was leaning against something (23%, n=163). The index finger was mainly used for browsing (54%, n=237). The users were mostly alone (38%, n=240) without any social interruptions (71%, n=170) doing nothing else around the time (just before, at the same time, right after) reading mobile news (39%, n=181).

"It [tablet] is usually on a table or on lap or I lean it on a knee. Very rarely I only hold it with my hands" – male, 45

The reading was mainly done by skimming through the version and choosing entire interesting articles for reading (31%, n=239), only its parts (29%, n=166) or only topics and the picture captions of interesting themes (26%, n=162). The tablet versions were read at once (all or all what wanted 32%, n=239), or only partly what wanted without getting back to it later (31%, n=239). Less than half of the users read only Keskipohjanmaa newspaper's on a tablet and did not access to other formats from the same content provider (47%, n=228). Those who read other

Keskipohjanmaa's content used traditional print (30%, n=228), or accessed it also on PC (57%, n=47).

"But surely news are more often read from [print] newspaper or via computer, with bigger screen." – male, 26

The most pleasant situation for news reading with tablet was at home (56%, n=18) or while commuting (44%), in the morning (33%) or in a peaceful moment (28%). Also on a couch (28%), at a table (22%) or wherever/everywhere (33%) would suit for news reading with tablet.

"[In which kind of situations you read news with tablet?] All kinds of situations, in the morning totally normally like morning newspaper and then, when you relax and when you do not have something to do, somewhere when you are waiting for something, and on the town and at home and at the beach and.." –female, 18

In sum, the overall reading experience of the tablet browser optimized versions was slightly pleasant, they provided slightly positive affect on the users having also slightly positive pragmatic, hedonic and overall quality but they increased slightly over time. Two versions, named KPK and Aalto, provided more pleasant UX compared to the third version (Metropolia) based on both expert evaluation and quantitative and qualitative results from user study. Tablet news readers mainly do not hold the tablet with hands but lean it on something else (e.g. table or body parts) and an index finger was used for browsing the content. They read alone without social interruptions concentrating only on reading the news doing nothing else around the same time. The content was read lightly concentrating on reader's interest and read at once without returning to it later on the same day (content changed

daily). One third of the participants read also other services by Keskipohjanmaa (the print or the content accessible via computer). The participants preferred to read news in the morning at home while other extra-time scenarios were also relevant for reading.

STUDY 2 – DIGITAL REPLICAS AND AUTHENTICATION

Method

The goal was to explore user experience of digital replicas of three newspapers and an authentication method, named Next Media key, during a one-week user study with actual users.

Participants - 17 native Finnish speakers completed the study. They were currently ordering the Aamulehti newspaper with its digital package. User's age ranged between 30-69 years (M=47, SD=12.0). There were nine men.

Replicas of digital news and authentication - The digital replicas of three newspapers published by Alma Media Oyj in Finland were included in the study: Aamulehti (AL) – a regional newspaper, Iltalehti (IL) – a country-wide evening newspaper, and Nokian Uutiset (NU) – a hyperlocal newspaper. AL and IL were executed with Adobe Flash and the open article –feature with XML). The execution of the NU was implemented with Adobe Flash for devices and user interfaces which supported it. For other versions it was provided as HTML 5 execution.

Context of study - The users could order for free as many of these digital replicas as they wanted (9/15 ordered all three) to use with their own computers (laptops or desktops) for one week in their daily life. The study was conducted in the middle of November 2013 when they usually were normally working.

Procedure – was similar to the study 1 (Figure 11 and [40]). The mechanism for using and ordering the digital replicas, called the Next Media –key, was also evaluated. Duration of use was one week.
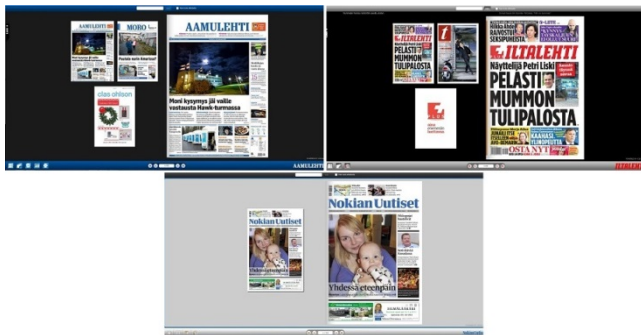

Figure 8. The digital replicas: Aamulehti (up left), Iltalehti (up right) and Nokian Uutiset (down).

The digital replicas were ordered by participants based on their own interests as they were new paying customers via the authentication method implemented for this study by VTT (Technical Research Centre of Finland): the Next Media –key. It had Logging page, Introduction page, Ordering page and the Main page. It was just a prototype of a concept in which multiple media products from multiple media companies could be ordered with just one logging in (with username and password). It was studied so that about its future development could be decided, and news organizations would gain practical experience of using this approach for their development purposes.
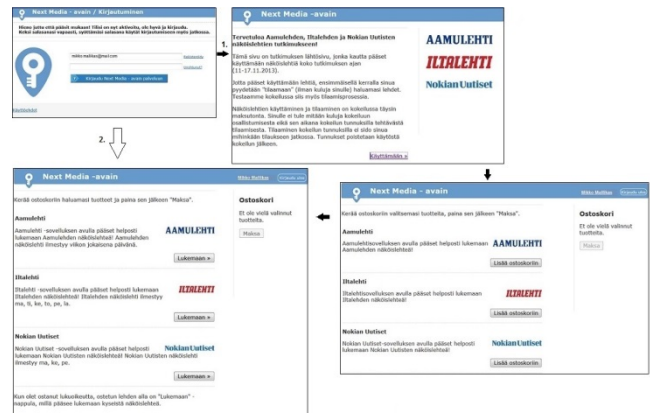

Figure 9. The navigation of the Next Media –key authentication.

Data-collection methods – The questionnaires and interviews were similar to study 1. The questionnaires, the I-PANAS-SF [36], AttrakDiff 2-SF [20], and the collected user experience (UX) pragmatics [1,12,52] and scales used were identical to the study 1. In addition for evaluating the Next Media –key authentication, a part of the Questionnaire of usability of online stores [13] with 7-point scale was used for measuring the first impressions of media purchase as the product was designed for this purpose.

Also two items (easiness, speed) of the After-Scenario Questionnaire [34] was used together with a comprehensive item (pleasantness) to gather data about user experience of the authentication daily. These metrics were evaluated with Likert 11-point scale (from 0 to 10). Finally overall smoothness of the logging in with the Next Media –key was measured and evaluated with Likert 4-point scale (4 automatic, 1 lot of problems). Six users participated to the interview which duration was at the maximum an hour.

Analysis – The analysis included in only users who had read digital replicas daily and finished study. The analysis of qualitative data was carried out similarly to the study 1.

Results

Retrospective evaluations – Two versions, named AL and IL, were the most pleasant ones while all three digital replicas provided similarly pleasant reading experience. The AL and IL were equally the most pleasant ones chosen by the users (6/14 each) after the study in the final questionnaire. Also all the tested versions had similarly pleasant overall reading experience (Mean > 7) after the
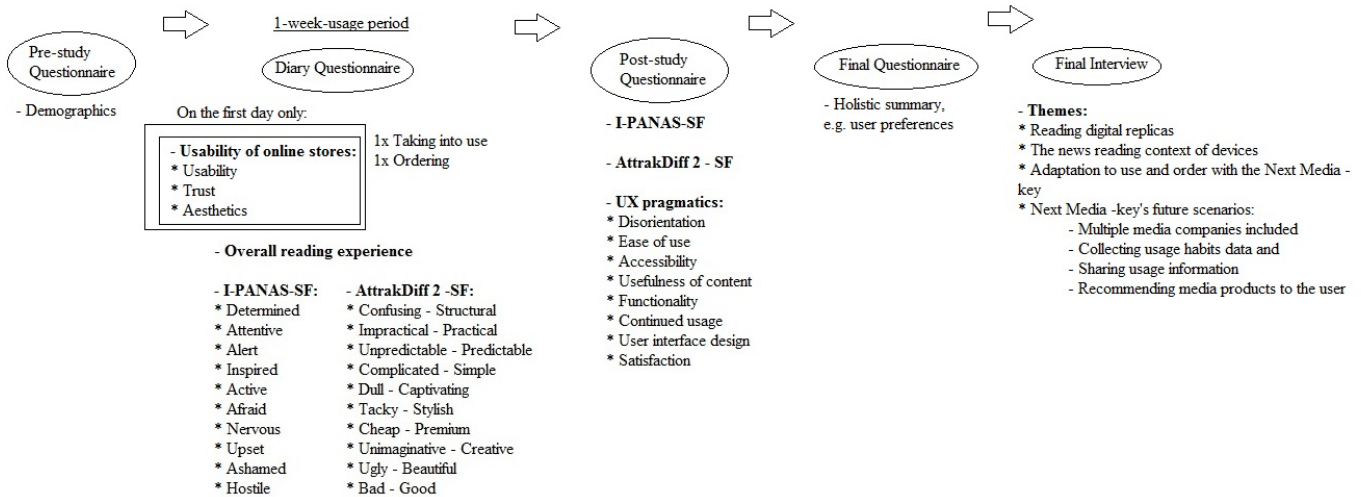
Figure 10 The procedure and the measures of the study 2.

usage. In all the dimensions – I-PANAS-SF, AttrakDiff 2-SF and the UX pragmatics - the digital replicas provided slightly positive experience to the users (Mean 4.6-6.3, Cronbach's α > 0.5; Figure 12-Figure 13).

The Next Media –key was evaluated to have slightly positive pragmatic experience on the users (Mean 4.1-6.3, Cronbach's α > 0.4 except Ease of use: α < -0.5) and the users could recommend it to their family and friends (73% agreed [5-7 values], n=15) after the usage period.

During the usage - The user experience was overall slightly positive in all measured dimensions: The overall reading experience (Mean 6.5-7.8), the positive affect, the pragmatic and the hedonic quality, and the appeal (Mean 3.4-5.7, Cronbach's α > 0.6; Figure 12-14). In sum, the overall reading experience of the digital replicas was pleasant and they provided positive affect on users having also positive pragmatic, hedonic and overall quality throughout the usage period.

During the usage period logging in with the Next Media – key was experienced smooth (Mean 1.5-1.7; Figure 14), and the overall user experience was pleasant, easy and fast (Mean 6.9-9.4; Figure 15).
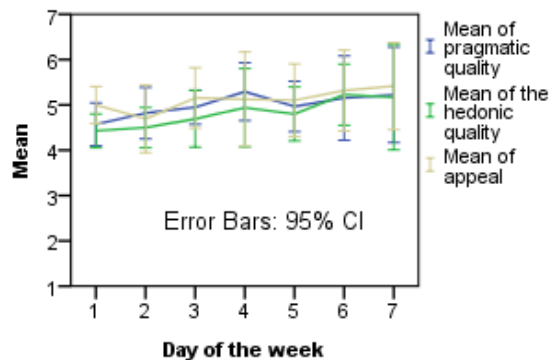

Figure 11. The overall reading experience of the digital replicas.

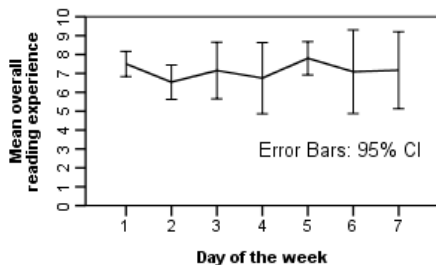**Figure 12. The AttrakDiff 2-SF of the digital replicas.**
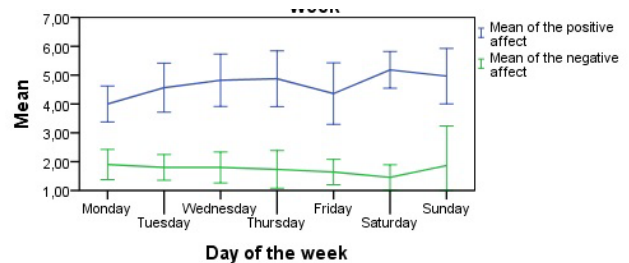
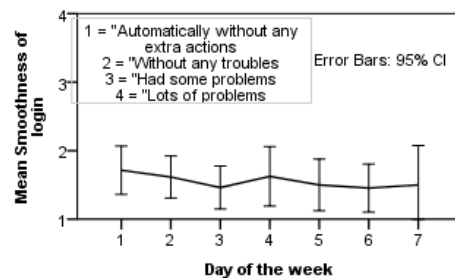**Figure 13. The PANAS short of the digital replicas.**

Figure 14. Logging in with the Next Media –key.

First vs. the last day – There is a tendency that some of the measured dimensions of UX of the digital replicas improve over time. When the mean values of the first and the last day of the usage week were compared the user experiences of the digital replicas increased slightly in the positive affect, the pragmatic and the hedonic quality and the appeal (0.4-1.0; Figure 12). The results of authentication showed a similar tendency. The smoothness of logging, easiness and speed in using the Next Media –key improved over time (0.2-0.9; Figure 15) when comparing the first and the last days of the study. However, the overall pleasantness decreased (0.2; Figure 15).
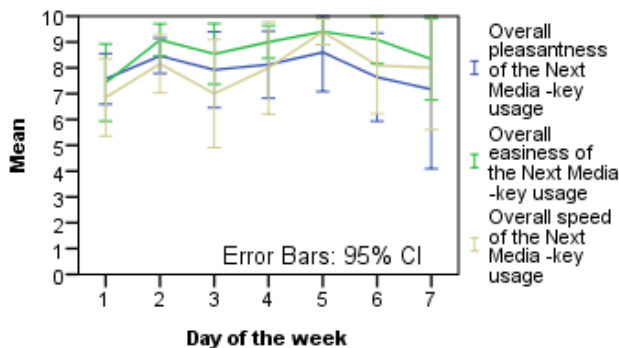
Figure 15. The overall user experience (ASQ) of the Next Media –key.

Final interview – The results of interview was collected retrospectively, and most interviewees had ordered all three newspapers (5/6). The digital replicas were experienced as clear and trouble-free and the users have enjoyed reading local news. The appearance of the digital replicas was clear (3/6) and local news in them was experienced pleasant (3/6) and the users had no technical problems while using digital replicas (3/6), especially IL was mentioned to be trouble-free (3/6).

The users' impressions of the new authentication method were positive (clear, simple, easy) without problems in functioning or usage. Overall, using the Next Media –key was experienced trouble-free (4/6), simple (4/6) and it functioned (3/6). Users saved the username and/or the password to the memory of the browser (3/6). Both taking the Next Media –key into use (3/6) and ordering with it (6/6) were trouble-free.

Usage context – All mentions from the daily diaries from the usage week were included in the analysis. It showed the digital replicas were read mainly in the morning (22%, n=201) or in the evening (24%, n=201), at home (30%, n=70) or at work (27%, n=22). The users read the news mainly alone (29%, n=73) or so that their spouse was present (26%, n=73) without interruptions (85%, n=72). Around the time the users were reading (just before, at the same time or right after) the digital replicas they did not do anything else (53%, n=74), or they ate or drank something (52%, n=79), or worked (61%, n=57).

"[news reading with computer is suitable for...] As said, at least at the moment the news reading is concentrated on the evenings anyway. And it might be that my girlfriend is perhaps reading some other news with laptop next to me." –male, 32

Participants read all they wanted at once without returning to the digital replicas later on over half of the time (54%, n=74), or only a part without still returning back to it later on (35%, n=74). They read mainly only all the interesting articles (50%, n=74) when they read digital replicas. The content of the tested digital replicas was not read from anywhere else (All 23%, n=47; IL and NU 36%, n=47; NU 19%) except that Aamulehti was read also as print (73%, n=45) and Iltalehti as web service (69%, n=26). In addition Iltalehti was also read with smart phone (50%, n=20), and both Aamulehti and Iltalehti with tablet (23%, n=22).

"[news reading with computer] I read now exactly in the same situations like I use tablet. So in the morning when I had a morning coffee-, one exception was exactly that, the coffee needs to be already drunk down when I go to the computer to read these [digital replicas]." –female, 66

In sum, the overall reading experience of the digital replicas was slightly pleasant, they provided slightly positive affect on the users having also slightly positive pragmatic, hedonic and overall quality. In addition the authentication method (the Next Media –key) was easy, fast and pleasant to use and smooth while logging in. The users' experience improved slightly over time in both cases. These results were identified in both quantitative and qualitative results. Digital replicas are read in the morning and evening alone without social interruptions at home or at work. Around the news reading time the digital replica readers do nothing else, eat or drink something or work. They tend to read only interesting articles all at once without returning to read the same digital replica again later. However the other services of the same newspaper (web services, print version or other content accessible by mobile devices) are sometimes read.

DISCUSSION

This study aimed at understanding user experience of mobile news reading in field conditions in two semi-long-term case studies. The first study compared three different forms of tablet browser optimized newspapers. The second study focused on UX of an authentication method for news reading of digital replicas. In both studies, the participants were active readers' of newspapers and familiar with comparable authentication methods.

Digital replicas and browser optimized versions of news and authentication methods provided positive experience in real context for the actual users. The preferred tablet browser optimized versions of digital news had close outlook to the conventional newspaper. The studied simple authentication method provided access to multiple digital news products. Even though the method tested was experienced easy and trouble-free, the results showed the needs for improvements of its features. However, when increasing features and services behind one authentication, future work needs to explore the designs/implementations

so that the users' have feeling of control over their information.

The results of both studies showed a tendency that UX slightly improves over time in a studied usage period of one week. This was identified in two different ways when studying the tablet browser optimized versions, the digital replicas and the authentication methods in several measured dimensions. During the first days user experience was lower than during the last days of the study (changes up to 1.5, on 7 or 11-point scale). In addition, UX was increasing throughout the week from the beginning to the end. When comparing these results to the previous work concluding the phases in long-term UX from taking into use to sustained use, interesting new research questions for further work are formed. Karapanos et al. [28] studied UX with novel products for users (iPhone with six users without previous experience on smartphones) for four weeks [28]. They concluded that satisfying product adoption contained three phases from initial orientation (dominated by stimulation and learnability) to subsequent incorporation of the product in daily routines (dominated by usefulness and long-term usability) and increased identification (dominated by personal and social experiences) [28]. Increasing familiarity, functional dependency and emotional attachment are the shifting forces in a process. In addition, their work highlighted the sharp decrease of UX after the first week of usage. Although the our study and this previous study are not directly comparable due to differences in samples, products, duration and familiarity, this combination raises the following questions for further work: What kind of patterns of adoption of changes in existing products have? How would the usage relate to Karapanos' model [28] e.g. would it directly start to follow e.g. usefulness and long-term usability? What would be a needed duration of a study for such a case?

Our results also showed that reading patterns of digital news followed the traditions of reading a print newspaper in two ways. Firstly, digital news readers still desire a traditional print newspaper parallel to the new forms of news and prefer newspaper-like outlook for digital news. Secondly, our results showed that users' read digital newspaper once a day, usually in the mornings. As our results underlined, newspaper-like outlook of browser optimized versions were preferred, reading of print and digital news was interleaved, and the preference order between the forms highlighted the superiority of print newspaper over browser optimized versions, and digital replica. Although preferring traditional print newspaper is not a new phenomenon, it is somewhat surprising after many developments and trials in the area of information technology during last 20 years users' still follow the existing conventions in their daily life [25,45,51]. Although digital news could be updated or modified at any time [29], it seems that readers' mental representation of digital news differentiates from close concepts and is still closer to conventional newspaper than updated online news. This representation might also direct the way to read the news following the existing conventions.

Future work
Future work is needed to deepen the understanding on the reading patterns of digital news. It is necessary 1) to explore the reading patterns with sensor data parallel to the subjective reports, 2) to study the needs for different forms of digital news and user's devices to understand the if pleasurable experienced can be formed only using one format, 3) explore the combination of content and form, and 4) finally, deepen the understanding on contextual aspects of digital news consumption on ubiquitous computing.

Evaluation and limitations
The design of this study aimed at maximizing external validity as users, newspaper content and user's own devices and usage context followed the actual usage situations. Furthermore, this study focused on two forms of digital news among numerous formats and authentication with relatively minimal functionality. The drop-out ratio, as a typical problem for longitudinal studies, was low (3 in total) in our studies indicating rather motivating and good quality than overwhelming data-collection procedure and resulting in a good sample sizes at the end [15]. Although the nature of field study restricts the generalizability of the results to comparable conditions, it provides interesting views to semi-long-term UX.

CONCLUSIONS
To conclude, this paper presented two case studies of mobile news reading over a period of two week with actual users in their actual contexts. The forms of studied digital news, tablet optimized versions, digital replicas and media authentication were all identified acceptable and even preferable for future of the digital news. The UX showed a tendency of improving over a time proving an interesting challenge of studying and modelling experiences of modifications to the existing products. Finally, after development of 20 years of digital news, its reading habits of still reflect the patterns of reading conventional newspaper.

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REFERENCES
1. Ahuja, J.S. and Webster, J. Perceived disorientation: an examination of a new measure to assess web design effectiveness. *Interacting with Computers* 2001 (14), 15-29. http://dx.doi.org/10.1016/S0953-5438(01)00048-0

2. All about UX. All UX evaluation methods. http://www.allaboutux.org/all-methods. Referred 07.07.2015

3. Althaus, S. L., and Tewksbury, D. Agenda setting and the "new" news patterns of issue importance among readers of the paper and online versions of the New York Times. *Communication Research*, 29, 2 (2002), 180-207. http://dx.doi.org/10.1177/0093650202029002004

4. Aranyi, G. Developing a psychological model of end-user's experience with news Web sites. Unpublished PhD thesis. Teesside University. 2012. Available at: http://tees.openrepository.com/tees/bitstream/10149/236331/4/236331.pdf

5. Aranyi, G. and van Schaik, P. Using think-aloud and psychometrics to explore users' experience with a news Web site. *Interacting with Computers*, 24, 2 (2012), 69-77. http://dx.doi.org/10.1016/j.intcom.2012.01.001

6. Aranyi, G. and van Schaik, P. Modeling user-experience with news websites. *Journal of the Association for Information Science and Technology.* 2015. http://dx.doi.org/10.1002/asi.23348

7. Aranyi, G. and van Schaik, P. Testing a model of user-experience with news websites. *Journal of the Association for Information Science and Technology.* 2015. http://dx.doi.org/10.1002/asi.23462

8. Ashton, E. and Cruickshank, G. The Newspaper of the Future: A Look Beyond the Front Porch. *Proceedings of the 14th National On-line Meeting*, (1993), 11-16. *In Shepherd, M., & Watters, C. The evolution of cybergenres. In System Sciences, 1998, Proceedings of the Thirty-First Hawaii International Conference on (Vol. 2, pp. 97-109). IEEE*

9. Bargas-Avila, J.A. and Hornbæk, K. Old wine in new bottles or novel challenges: a critical analysis of empirical studies of user experience. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM. (2011), 2689-2698. http://dx.doi.org/10.1145/1978942.1979336

10. Bertini, E., Gabrielli, S. and Kimani, S. Appropriating and assessing heuristics for mobile computing. *Proceedings of the working conference on Advanced visual interfaces*. ACM (2006), 119-126. http://dx.doi.org/10.1145/1133265.1133291

11. Bolger, N., Davis, A., and Rafaeli, E. Diary methods: Capturing life as it is lived. *Annual review of psychology*, 54, 1 (2003), 579-616. http://dx.doi.org/10.1146/annurev.psych.54.101601.145030

12. Cho, V., Cheng, E.T.C., and Lai, J.W.M. The role of perceived user-interface design in continued usage intention of self-paced e-learning tools. *Computers & Education*. 53, 2 (2009), 216-227. http://dx.doi.org/10.1016/j.compedu.2009.01.014

13. Christophersen, T. and Konradt, U. Reliability, validity and sensitivity of a single-item measure of online store usability. *International Journal of Human-Computer Studies* 69.4 (2011), 269-280. http://dx.doi.org/10.1016/j.ijhcs.2010.10.005

14. Chung, C. J., Kim, H., and Kim, J. H. An anatomy of the credibility of online newspapers. *Online Information Review,* 34, 5 (2010), 669-685. http://dx.doi.org/10.1108/14684521011084564

15. Courage, C., Jain, J., and Rosenbaum, S. Best practices in longitudinal research. *In CHI'09 Extended Abstracts on Human Factors in Computing Systems* (2009), 4791-4794. ACM. http://dx.doi.org/10.1145/1520340.1520742

16. d'Haenens, L., Jankowski, N., and Heuvelman, A. News in online and print newspapers: Differences in reader consumption and recall. *New Media & Society*, 6, 3 (2004), 363-382. http://dx.doi.org/10.1177/1461444804042520

17. Duggan, G. B., Johnson, H., & Grawemeyer, B. Rational security: Modelling everyday password use. *International journal of human-computer studies*, 70, 6 (2012), 415-431. http://dx.doi.org/10.1016/j.ijhcs.2012.02.008

18. Friedrich, P., Mensonen, A., Aikala, M., Grenman, K. Digital Newspaper Makes My Home Tidier – Evaluating User Experience with User-Defined Attributes. *27th Bled eConference, eEcosystems* (2014).

19. Halpert, B. J. Authentication interface evaluation and design for mobile devices. *In Proceedings of the 2nd annual conference on Information security curriculum development* (2005), 112-117. ACM. http://dx.doi.org/10.1145/1107622.1107649

20. Hassenzahl, M., and Monk, A. The Inference of Perceived Usability From Beauty. *Human-Computer Interaction* 25, 3 (2010), 235-260. http://dx.doi.org/10.1080/07370024.2010.500139

21. Hassenzahl, M., and Tractinsky, N. User experience-a research agenda. *Behaviour & Information Technology*, 25, 2 (2006), 91-97. http://dx.doi.org/10.1080/01449290500330331

22. Heikkilä, H. Towards tablet publication heuristics: Improving accessability, usability and user experience with new expert evaluation. Next media program of TIVIT (2013). Available at: http://www.academia.edu/3561786/Towards_tablet_publication_heuristics_Improving_accessability_usability_and_user_experience_with_new_expert_evaluation

23. Hoonakker, P., Bornoe, N., and Carayon, P. Password authentication from a human factors perspective: Results of a survey among end-users. *In Proceedings of the Human Factors and Ergonomics Society Annual*

Meeting 53, 6 (2009), 459-463. SAGE Publications. http://dx.doi.org/10.1177/154193120905300605

24. Ihlström, C., and Lundberg, J. The Audience of Swedish Local Online Newspapers:-a Longitudinal Study. *Technology interactions: proceedings of the 6th International ICCC IFIP Conference on Electronic Publishing* (2002). Republic, 6-8 November, 2002 (pp. 92-102).

25. Ihlström, C., and Åkesson, M. Genre characteristics-a front page analysis of 85 Swedish online newspapers. *Proceedings of the 37th Annual Hawaii International Conference on System Sciences*. IEEE (2004), 1-10. http://dx.doi.org/10.1109/HICSS.2004.1265274

26. Jain, J. Rosenbaum, S. and Courage, C. Best practices in longitudinal research. *In CHI '10 Extended Abstracts on Human Factors in Computing Systems* (2010), 3167-3170. ACM. http://dx.doi.org/10.1145/1753846.1753946

27. Jordan, P. W. Designing pleasurable products: An introduction to the new human factors. CRC Press (2000), 159.

28. Karapanos, E., Zimmerman, J., Forlizzi, J., & Martens, J. B. User Experience Over Time: An Initial Framework. (2009). http://www.ekarapanos.com/UXOT_CHI09.pdf

29. Karlsson, M., and Strömbäck, J. Freezing the flow of online news: Exploring approaches to the study of the liquidity of online news. *Journalism Studies*, 11, 1 (2010), 2-19. http://dx.doi.org/110.1080/14616700903119784

30. Karlof, C. K. Human Factors in Web-Authentication (No. UCB/EECS-2009-26). California University Berkeley Department of Electrical Engineering and Computer science. Doctoral Thesis.(2009).

31. Koskinen, J. Verkkoaineisto Tampereen Teknillisen Yliopiston kursseille:"Tietoverkot ja tietoturva","Tietoturvallisuuden perusteet" ja"Tietoturvallisuuden jatkokurssi" Web material for courses: "Information networks and information security", "Basics of information security" and "Advanced course of information security" of Tampere University of Technology. (2014) Available: http://sec.cs.tut.fi/maso/valinta.php. Referred 23.11.2014.

32. Kujala, S., Vogel, M., Pohlmeyer, A.E. and Obrist, M. Lost in time: the meaning of temporal aspects in user experience. *In CHI '13 Extended Abstracts on Human Factors in Computing Systems* (2013), 559-564. ACM. http://dx.doi.org/10.1145/2468356.2468455

33. Lahikainen, E . Modernin mobiilisovelluskehityksen pääparadigmat: Ehdotus monialustaisten mobiilisovelluksien heuristiikoiksi. University of Jyväskylä. Pro Gradu. (2013). Available at: https://jyx.jyu.fi/dspace/bitstream/handle/123456789/4 1644/URN%3ANBN%3Afi%3Ajyu-201305301854.pdf?sequence=1

34. Lewis, J.R. An after-scenario questionnaire for usability studies: psychometric evaluation over three trials. *ACM SIGCHI Bulletin* 23, 4 (1991), 78-81. http://dx.doi.org/10.1145/126729.1056077

35. Lu, Y., Wang, X., & Ma, Y. Comparing user experience in a news website across three devices: iPhone, iPad, and desktop. *Proceedings of the American Society for Information Science and Technology,* 50, 1 (2013), 1-4. http://dx.doi.org/10.1002/meet.14505001141

36. Mackinnon, A., Jorm, A. F., Christensen, H., Korten, A. E., Jacomb, P. A., and Rodgers, B. A short form of the Positive and Negative Affect Schedule: Evaluation of factorial validity and invariance across demographic variables in a community sample. *Personality and Individual differences* 27, 3 (1999), 405-416. http://dx.doi.org/10.1016/S0191-8869(98)00251-7

37. Neuman, B. C., & Ts'o, T. 1994. Kerberos: An authentication service for computer networks. *Communications Magazine*, IEEE, 32(9), 33-38. http://dx.doi.org/10.1109/35.312841

38. Nielsen, J. "Severity ratings for usability problems." Papers and Essays. (1995). http://katsvision.com/canm606/session_2/M2_reading4 .pdf

39. Nielsen, J. and Molich , R. Heuristic evaluation of user interfaces. *In Proceedings of the SIGCHI conference on Human factors in computing systems*. ACM Press (1990), 249–256. http://dx.doi.org/10.1145/97243.97281

40. Pesonen, E. The User Experience of Digital News: Reading and Authentication on Browser Optimized Versions and Digital Replicas. Master of Science thesis. (2015) Tampere University of Technology. pp. 14-16.

41. Reuters Institute. "Reuters Institute Digital News Report 2014: Tracking the Future of News." Reuters Institute for the study of journalism, University of Oxford. (2014), 8-9, 30-31. Edited by Newman, N. & Levy, D.A.L.

42. Rhodes-Ousley, M. Information security the complete reference. 2nd Edition. McGraw-Hill Osborne Media (2013), 167, 187-188.

43. Roto, V., Law, E., Vermeeren, A. P. O. S., and Hoonhout, J. User experience white paper: bringing clarity to the concept of user experience. In Dagstuhl Seminar on User Experience (2011). http://www.leerbeleving.nl/wbts/wbt2014/blend-ce.pdf

44. Salminen, M. Mobile navigation with mirror worlds: user experience and needs. Master of Science thesis. (2013). Tampere University of Technology.

45. Shapira, B., Shoval, P., Tractinsky, N., and Meyer, J. ePaper: A personalized mobile newspaper. *Journal of the American Society for Information Science and Technology,* 60, 11 (2009), 2333-2346. http://dx.doi.org/110.1002/asi.21172

46. Strauss, A., and Corbin, J. Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory (2nd ed.). Thousand Oaks, CA: Sage (1998).

47. Tewksbury, D., and Althaus, S. L. Differences in knowledge acquisition among readers of the paper and online versions of a national newspaper. *Journalism & Mass Communication Quarterly*, 77, 3 (2000), 457-479. http://dx.doi.org/10.1177/107769900007700301

48. Vaughan, M. W., & Dillon, A. Why structure and genre matter for users of digital information: A longitudinal experiment with readers of a web-based newspaper. *International Journal of Human-Computer Studies*, 64, 6 (2006), 502-526. http://dx.doi.org/10.1016/j.ijhcs.2005.11.002

49. Vermeeren, A.P., Law, E. L-C., Roto, V., Obrist, M., Hoonhout, J. and Väänänen-Vainio-Mattila, K. User experience evaluation methods: current state and development needs. *Proceedings of the 6th Nordic Conference on Human-Computer Interaction: Extending Boundaries.* ACM (2010), 521-530. http://dx.doi.org/10.1145/1868914.1868973

50. von Wilamowitz-Moellendorff, M., Hassenzahl, M. and Platz, A. Dynamics of user experience: How the perceived quality of mobile phones changes over time. In the 2nd COST294-MAUSE International Open Workshop (2006): 74-78.

51. Watters, C.R, Shepherd, M.A., Chiasson, T. and Manchester, L. An evaluation of two metaphors for electronic news presentation. Technical Report. Computing Science Division, Dept. of Mathematics, Statistics & Computing Science, (1996) http://link.springer.com/chapter/10.1007/978-3-540-39916-2_17

52. Yang, Z., Cai, S., Zhou, Z., and Zhou, N. Development and validation of an instrument to measure user perceived service quality of information presenting web portals. *Information & Management* 42, 4 (2005), 575-589. http://dx.doi.org/10.1016/j.im.2004.03.001